New
3 vol

____________________1901.

Received of N. W. Gifford, Secretary, one copy of Proceedings for 1900 and 1901.

____

Very truly Yours

[illegible]

PROCEEDINGS

OF THE

New England Association of Gas Engineers

AT THE

Thirtieth and Thirty-first Annual Meetings

YOUNG'S HOTEL, BOSTON, MASS.,

Feb. 21 and 22, 1900, and

Feb. 19 and 20, 1901.

NEW BEDFORD, MASS.:
NEW BEDFORD PRINTING COMPANY.
1901.

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PROCEEDINGS

OF

THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,

THIRTIETH ANNUAL MEETING, FEB. 21 AND 22, 1900.

First Day, Feb. 21—Morning Session.

The President (Mr. Walter R. Addicks, Boston) called the meeting to order at 10 A. M. The Secretary (Mr. N. W. Gifford, New Bedford, Mass.) occupied the recorder's chair. The reading of the minutes of the last meeting having been dispensed with, the President called for

REPORT OF THE BOARD OF DIRECTORS,

which was read by the Secretary:

TO THE MEMBERS OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS:

Your Directors, at a meeting held February 20th, 1900, voted to recommend for election to membership in this Association the following gentlemen:

ACTIVE.—Louis J. Hirt, Chief Engineer, Mass. Pipe Line Gas Company, Everett, Mass.; John D. Milne, Supt. gas division, Connecticut Lighting and Power Company, Norwalk, Conn.; F. M. Travis, Supt. gas division, Torrington (Conn.) Electric Light Co.; C. E. White, Manager Wakefield (Mass.) Municipal Light Plant.

ASSOCIATE.—H. N. Cheney, Bay State Gas. Co., Allston, Mass.; Albert Dunbar, Supt. Distribution, Brookline (Mass.) Gas Co.; John T. Fiske, Concord, N. H.; F. A. Langforth,

Director New Haven (Conn.) Novelty Machine Co.; G. F. Macmun, Jr., Marlboro (Mass.) Gas Light Co.; H. E. Thompson, New Haven (Conn.) Novelty Machine Co.; F. Tudor, Jr., Treas. Massachusetts Pipe Line Co., Boston, Mass.; W. L. Walker, Fitchburg, Mass.

TRANSFER FROM ASSOCIATE TO ACTIVE.— F. H. Sargent, Supt. Lawrence (Mass.) Gas. Co.

ELECTION OF NEW MEMBERS.

On motion of Mr. Harbison, the report was accepted. On motion of Mr. Prichard, the Secretary was instructed to cast the ballot of the Association in favor of the election to membership of the gentlemen named. The Secretary reported that he had carried out the instruction, whereupon the President declared the election, and invited the new members to actively participate in the meeting. The resignation of Mr. E. B. Lewis and Mr. H. W. Waldron were accepted.

NOMINATING COMMITTEE.

The President appointed Messrs. C. F. Prichard, S. J. Fowler and F. C. Sherman a committee to nominate officers for the ensuing year.

WELCOMING THE VISITORS.

The President at this point extended a hearty welcome to the members of other Associations, as well as other visiting members of the fraternity, and hoped they would practically join in the proceedings.

REPORT OF THE TREASURER.

Secretary and Treasurer Gifford read his annual report, which showed receipts for the year amounting to $903.82 and expenditures amounting to $663.19. The total balance of cash in hand was returned at $826.40. On motion, the report (which had been indorsed by the Board of Directors and an auditing committee) was accepted. On motion of Mr. Prichard a

TELEGRAM TO THE MICHIGAN GAS ASSOCIATION

in session in seventh annual meeting at Detroit, extending congratulations and good wishes, was ordered forwarded.

LETTERS OF REGRET.

The Secretary read many letters, from persons prominently identified with the gas industry, regretting the inability of the writers to respond in person to the invitation to be present at the meeting. Amongst the communications of this nature was one from Mr. T. C. Jones, Secretary of the Ohio Gas Light Association, who, on behalf of the latter, extended an official invitation to the New England Association to join in the Ohio's meeting, to be held in Columbus, O., March 21 and 22. On motion of Mr. Harbison, the invitation was formally accepted, and Secretary Gifford was instructed to so notify the Ohio Association.

The President then read as follows his

INAUGURAL ADDRESS.

TO THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS:

We meet today, in this last year of the century, to celebrate the 30th annual meeting. We thus face a new century and a new decade for progress. There is something very personal about a birthday anniversary, and it justifies and perhaps is the origin of the customary presidential address. Your president is one of your number detailed to assume, for the time being for the whole Association, retrospective and contemplative powers which should be exercised within the limits prescribed by the articles of agreement of the Association, the preamble of which reads, "Whereas, The manufacture and supply of gas has become one of the largest economic interests in the country; and, whereas, it is most important to the manufacturers and to the public that the best processes known shall be employed in its manufacture and distribution; and, whereas, it is most desirable to obtain the advantage of the experience of the gas engineers scattered throughout New England upon the various problems presented for consideration, we, the undersigned, hereby agree to associate ourselves for the above named purpose. * * *"

The past year has been a period of great commercial activity in all lines. This fact has doubtless had its due influence in increasing both our gas and electric light sales. Our satisfaction is somewhat modified by the large increase in the price of all materials and supplies. To single out one commodity

as illustrating this fact more than some other would require special study. One fact stands out most prominently — there has been no advance in the price of gas. Even the railroads have advanced their charges for transportation. This increase in the price of material used in gas manufacture by very large percentages must affect companies working under close management, and under supervision of established authority, in reduced dividends or entire cessation of dividends, or resort must be had to the prevailing method by increasing the selling price for gas. Such gas undertakings without such increase would otherwise present the curious anomaly of poverty in the midst of plenty. No present or prospective increase in business will compensate for the advance in cost of materials we have witnessed and are still witnessing. Within a week I read that enormous shipments of coal to England will increase the cost of Pittsburg coal 50 cents per ton. Increase in business involves increase in facilities for handling this business. The capital for undertaking it should be cared for out of the profits on this increase. We are in a period when the normal policy would curtail new construction. I am impressed with the fact that the history of the New England gas business is being added to so rapidly that the prophet must be indeed a prophet, and be certain that his inspiration is indeed inspiration, ere he dare prophesy the coming events.

I am by disposition optimistic, and I bid the future welcome. I am sure of one thing — we are all as citizens ready to perform our duty by our country, our state, our community and our corporation. The higher the quality of management required the closer we are required to attend to our respective duties and the more valuable do we become as engineers to our companies. Appreciation for our Association and society meetings is intensified by the demands made upon us. Let us make good use of such opportunities as may present themselves today.

The most prominent undertaking in New England at this time is that of the New England Gas and Coke Company and the Massachusetts Pipe Line Gas Company. We are fortunate in having the Chief Engineer of these Companies enter into our discussions. I believe that you will be impressed with the fact that, as a descriptive title, "The New England Coke Company" would have been more appropriate for this Company to have chosen.

In the production of coke gas is but a small factor, and if the plant is conducted entirely on a coke producing basis the maximum demand period may not be found to be coincident with that of the gas business. It is the present impression that gas producers will be convenient for this reason, and likewise to care for the variations in atmospheric conditions. That heat and cold, wet and dry weather must have appreciable effect on the quantities of gas required for heating the vast ovens of this process is self-evident. If coke were used for fuel, as in your retort furnaces, this would be equally true, but the requirements of the coke trade are not so inexorable as the gas output. You can say to your coke consumer, "No coke for sale today;" but your gas consumer has the matter in his own hands. The increased demands on the gas by the ovens and the gas consumer are coincident. In cold weather for heat, in both cases, and in wet weather by the ovens for driving out the moisture from the coal and from the oven structure, and by the consumer because wet weather means dark and frequently raw days. But the gas producer will also fill another place. It would be indeed an odd coincidence it the line of available surplus gas, and gas of satisfactory quality to be available for city use, should exactly correspond. If any of the gas now by necessity used for heating ovens is of satisfactory candle power and purity, its replacement by producer gas is natural. Producers will, therefore, give an elasticity to the plant that would not be undesirable. I am sure we can congratulate the management of the Companies upon the candle power and the purity of their gas, though made from coal higher in sulphur than the gas coal most of us are fortunate enough to be able to obtain. Tight ovens and large purification capacity are the primary essentials that bring about this result.

While on this subject I cannot resist musing for a moment. Imagine a vast area having the following apparatus arranged in parallel rows multiplied indefinitely. Beginning at the left:

1. First, a long line of 1,500–3,000-horse power gas engines, with alternating current dynamos direct connected and supplementing.

2. Second, a long line of triple expansion, vertical steam engines of 3,000-horse power each, direct connected to alternating current dynamos of appropriate k. w. capacity.

3. Third, a long line of boilers drawn up like a regiment of soldiers, with ample firing room space to the right and fronts fitted with automatic strokers, facing on the same firing floor and opposite the boiler fronts.

4. Fourth, a long line of producers fitted with up-and-down air and steam supply.

5. Fifth, a line of water gas apparatus of the Lowe type.

6. Sixth, a line of inclined retort stacks.

7. Seventh, a line of coke ovens.

Appropriate condensing and purifying plant and holder are readily conceived to care for the retorts and ovens and water gas apparatus.

What could we do with such a plant?

A. The gas engines could supplement the steam engines by using either producer gas, poor run-of-coke oven gas or illuminating gas, depending upon the demands made on these products or the desire of the management.

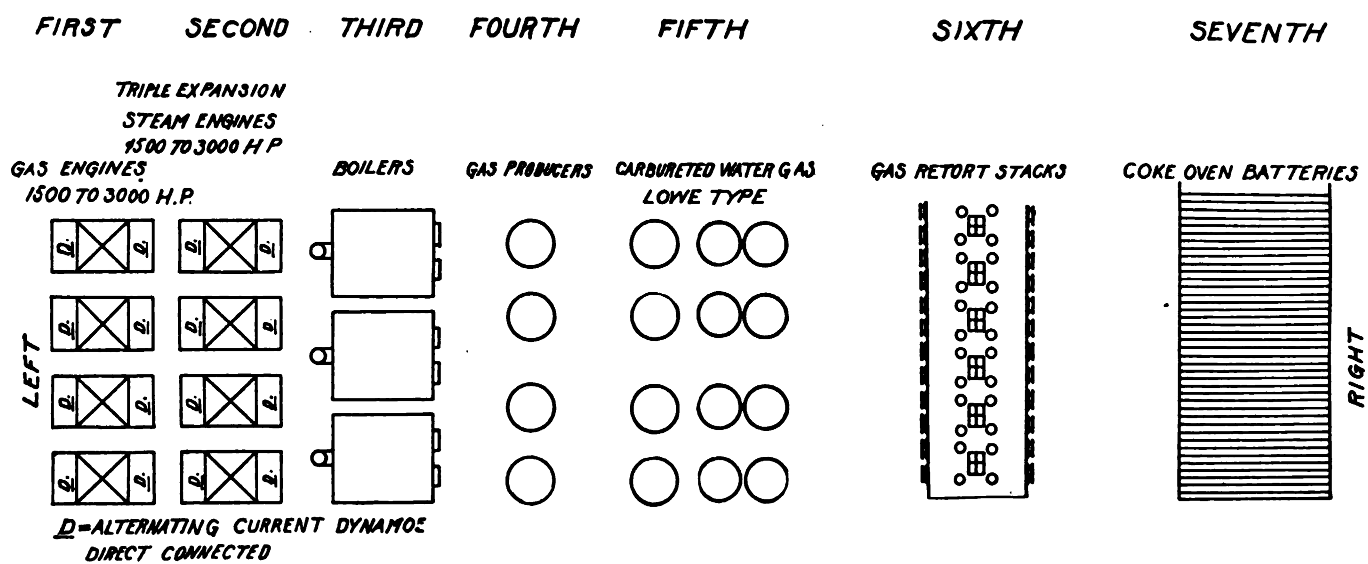
B. The steam engines would turn the steam from any boilers in use into a. c. electricity. This power could be of any desirable voltage, and be used for all the railways and electric lighting companies of the community, using step-down transformers, rotary transformers, constant current transformers, etc., depending upon the work required.

C. The boilers could be fired with coal or coke, by stokers or by automatic stokers, or by means of the producers opposite, or by means of the gas from the coke ovens when producing beyond needs for other useful purposes.

D. The producers could supply the boilers with heat as stated, but they could also supply the gas engines with producer gas as well as the coke ovens with heat. And also blue gas could be made for the Wilkinson process.

E. The water gas apparatus would supplement the coal gas apparatus and allow the retorts and ovens to run at constant and uniform rate independent of gas demands.

F. The inclined retorts would produce a steady supply of illuminating gas. We would here use the least weights of coal for the greatest number of feet of gas. The coke would be used when suitable for the demands of the community, any surplus to be used in the station — under the boilers for instance.



FIRST
SECOND
THIRD
FOURTH
FIFTH
SIXTH
SEVENTH
TRIPLE EXPANSION
STEAM ENGINES
1500 TO 3000 H P
GAS ENGINES
1500 TO 3000 H.P.
BOILERS
GAS PRODUCERS
CARBURETED WATER GAS
LOWE TYPE
GAS RETORT STACKS
COKE OVEN BATTERIES
LEFT
RIGHT
D = ALTERNATING CURRENT DYNAMOS
DIRECT CONNECTED

G. The coke ovens would supply partly the illuminating gas demands, and perhaps to factories adjoining, for tempering and furnace requirements when exact ranges of temperatures are essential. The producers would care for the oven demand.[1] Metallurgical coke or other grades could be produced at will.

I do not need refer to the tar establishment and ammonia house which would be a necessary adjunct to this plant.

Yes, fellow members of the New England Association, I am musing; but turn it over in your own minds, if only to satisfy yourselves that this is no time to be pessimistic as to the future of your profession. I dare to say in the face of possible misapprehension that the gas business of the future will be conducted by men who, while combining knowledge of engineering, civil, mechanical and electrical, and of metallurgy and chemistry, must also have business experience in their profession such as you have or are obtaining from day to day and year to year. I know of no profession requiring such a wide range of knowledge, practical and theoretical, as this same gas business that seems so simple in its processes. Do not permit the opportunities to slip from your grasp. If your sons are to follow in your footsteps see to it that they strive for a high standard of excellence.

GAS ENGINES.

Not very many years ago but one or two makes of gas engines were on the market; today new names present themselves in any technical journal you may pick up. The horse power of gas engines is now measured by thousands. We are chiefly interested in the smaller powers. I present a few figures based on a 10 horse power engine with dynamo attached, including foundations, switchboard, etc., complete for electric lighting and other power purposes gas is assumed for convenience at $1 per 1,000.

Cost per Horse Power, $176.50; *Gas at* $1 *per* 1,000.

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1. It is to be noted in passing that the fitting up of coke ovens, to do the identical work coal gas through retorts do in the Wilkinson process, is but the work of the gas engineer. The gas producers (D) would furnish the blue gas required.

	Load= Full.	Half.	Quarter.
1. Efficiency	100 per ct.	60 per ct.	51 per ct.
2. Cost gas per horse power, cts.	1.8	3.0	3.5
3. Cost per k. w., cents	3.0	5.0	5.83
4. Cost per inc. lamp-hour, cents	.18	.3	.35
5. Cost per arc lamp, cents	1.8	3.0	3.5
6. [1]Interest, depreciation and repairs, per horse power hour,	.88	1.76	3.42

I believe the day is coming when the electric light company will find the gas engine a factor in the competition for the business of supplying electric light to the large office buildings and department stores.

ELECTRIC LIGHTING STATIONS.—To those of you who have electric lighting stations the modernizing of your stations is an interesting study. Study of the subject convinces me that compound and triple expansion engines, direct connected to alternating current dynamos, are to be used exclusively for our stations. If the alternating enclosed arc can be successfully and satisfactorily used on an extensive scale by the use of constant current transformers, our main supply lines can be kept at a minimum. A 500-volt power circuit can care for the elevator and power and railway service by means of rotary transformers. Keeping the power and lighting on separate circuits has its advantages. The lighting circuits being more likely to fail, the consumer has gas to fall back upon. The following figures are suggested as probable efficiencies deduced from a consideration of the subject:

	Efficiency from throttle to switchboard at maximum load may reach
Station having compound engines with belt driven jack shafts driving alternate and direct current dynamos for both arcs and 500 vt. power	75 per cent.
Station having compound engines direct connected to alternating machines; alternating current arcs and rotary transformers for 500 vt. power current	88.6 "
Same, except with alternating motor driven, direct current arcs	85 "

1. Attendance may be taken at 2 1-2 times this (6) amount if a man's entire time should be devoted to this small plant. This should not be the case. The cost per horse power, exclusive of foundations, dynamos, switchboards, etc., for large powers, may be assumed between $50 and $60.

The unaccounted-for current in electrical circuits I find to be as important a subject for observation as the unobserved gas unaccounted for. It is not alone necessary to have a perfect station service, but the process of "scrapping" electric machinery and buying better has an appreciable effect on gas competition.

One is led to believe, when first attempting to run both plants — illuminating gas and electric light — that they are in competition. They are; but the demand for electricity is entirely independent of its cost and must be met. The best result obtainable is, therefore, essential to keep up with the times.

The Wright Discount Meter is destined, it would seem, to increase in use as time goes by.

Gas engines for producing power for electric stations is a subject that will repay your attention. I would not confine your investigation to illuminating gas, but consider the utilization of blue gas and producer gas and a mixture of the two. Natural gas is used on these large engines where it is obtainable.

ELECTROLYSIS.— Electrolysis is still a subject of careful consideration. I recommend that you appoint a standing committee to keep in touch with the subject, and with authority to correspond with any committee of any society which has authority to consider it. I wish to emphatically disavow any intention by this suggestion to revive the federation scheme which gave me such fruitless work some years ago. Federation principles can be successfully carried out by more than one Association on the lines of a Democratic rather than an Oligarchic form of government.

THE PREPAYMENT METER.— This apparatus is still a bone of contention. If it were universally conceded that it was the correct thing to make an extra charge of, say, 15 cents per 1,000 for gas sold through this form of meter, I conceive that any opposition to the meter would disappear. I assume, then, that the prepayment meter as a mechanical contrivance is not the bone of contention. I have made a study of an important matter lately and I am going to call the attention of the Association to it at this time.

If you turn to the Gas Commission reports of past years you will notice that the sales of gas through meters is less per meter than it formerly was. The following table illustrates this:

Year.	Gas Sold per Consumer. Company. Boston.	So. Boston.	Gas Sold per Meter Light. Company. Boston.	So. Boston.
1887	37,475	20,169	3,837	5,599
1888	37,507	20,927	3,609	4,115
1889	37,877	21,440	3,934	4,229
1890	38,195	22,091	3,796	4,325
1891	44,069	23,419	4,216	4,620
1892	46,427	23,831	4,453	4,668
1893	46,327	27,831	4,457	5,531
1894	37,623	24,730	3,701	4,939
1895	36,442	23,654	3,712	4,664
1896	34,410	18,177	3,572	3,867
1897	36,417	22,240	3,807	5,049
1898	36,893	22,883	3,812	5,213
1899	36,759	21,355	3,819	4,904

You will at once conclude, and correctly I think, that the large consumers of gas have been the ones discontinuing the use of gas in favor of electricity made by central stations and private plants. The electric company's average consumer is one who is better off financially than the average gas consumer. As evidence of this it is the custom in many electric light companies to charge a minimum rate of at least $1 per month to even the smallest consumer. In connection with studies on the price of gas in the abstract, I found I needed certain facts to help me bring my preconceived notions, amounting to belief, to hard, cold facts. Obtaining the cooperation of the Treasurer's domains, I found facts that well nigh overpowered me, and I am going to produce some of them.

NUMBER OF METERS REGISTERING AS INDICATED.

Registration in Cubic Feet Between	Company A.				Company B.				COS. A,B,C,D,E	
	Dec., 1898.		July, 1899		Dec., 1898.		July, 1899.		Dec., 1898.	
	No.	Per Ct.	No.	Pr.Ct.	No.	Pr Ct.	No.	PrCt	No.	Pr.Ct.
0- 100	4,237	14.71	10,877	38.5	130	2 66	482	9.7	12,375	15 88
100- 1,000	4,896	17 00	6,294	22.1	1,578	32.32	2,259	45 5	14,062	18.05
1,000- 2,000	4,904	17.1	4,985	17.58	1,573	32 32	1,309	....	16.741	.....
2.000- 3,000	3,479	12.1	2,503	8.8	650	13 31	439	....	11,199	.....
3,000- 4.000	2.452	8.51	1.198	4.21	331	....	203	....	6,729	.....
4.000- 5,000	1,808	6.53	644	2.27	191	....	78	....	4,869	.....
5.000- 7,000	2,386	8 35	683	2.40	183	....	73	....	4,322	.....
7,000-10,000	1,958	6 8	525	1.85	107	....	62	....	3,284	.....
0-10,000 ft.	26,120	90.8	27,709	97.5	4,743	97.1	4,905	98.7	73,581	94.00

The figures to me are most remarkable. Taking Company A, nearly 22 per cent. of the meters measured less than 1,000 feet in December, and nearly 61 per cent. measured less than 1,000 feet in July.

The Company is subject to electric light competition, and the people leave the city to summer to great extent in certain districts. In Company B, 35 per cent. of the meters measured less than 1,000 feet in December, and 55 per cent. of the meters measured less than 1,000 feet in July. Here electric light competition cuts little into the gas business and the people do not leave their homes universally.

In the combination Companies A-C, in December, 34 per cent. of all meters burn under 1,000 feet, and 94 per cent. of all meters less than 10,000 cubic feet. Below is an isolated record of prepayment meter which gives an extraordinary large return. Our records show no gas having been used at No. 10 Causeway St., though the building had been provided with a service for 20 years. One of our solicitors arranged for a prepayment meter at this place in October, 1897. This building is within two blocks of our old North End station. The money collected from meter is as follows:

	1897	1898	1899	1900
Jan		$10.50	$9.25	$9.50
Feb		9.25	10.00	18.00
March		3.50	8.00	....
April		11.50	9.00	....
May		8.25	8.25	....
June		6.75	4.25	....
July		6.25	4.00	....
Aug		6.50	8.75	....
Sept		7.00	5.75	....
Oct	$6.00	7.25	11.75	....
Nov	11.75	8.50	20.75	....
Dec	9.80	8.00	11.75	....
Total,	$27.55	$93.25	$111.50	

Now, in the face of the facts deducted in the tables above, are these not fair questions: (A), Will the introduction of prepayment meters stimulate the use of gas when the present use is restricted; and, (B), Will not the prepayment meter tend to increase the average use of gas per meter per month.

Technical Gas Press.— During the past year gas publications have been filled with valuable matter. I am glad to see them publishing increasing quantities of matter on steam and electricity. Quotations of coke, cast iron, ammonia, tar, etc., are not less welcome. We owe a debt to the gas press not measured by the subscription price.

Incandescent Gas Lamps.— Anyone driving or riding throughout the city of Boston and town of Brookline, will be struck with the improved lighting of the streets at night, the 4-feet glycerine burner being replaced by the standard Welsbach street light. I hope to see boulevards lighted by 4 rows ot Welsbach lights before long. Driving in a shady street is now made more safe for the driver, as well as walking for the pedestrian. The investigation of this matter will repay you. You remember that last year Mr. Fowler touched upon the desirability of this method ot street lighting.

Gas Stoves.— New designs of gas stoves are coming forward with ever-increasing attractive features. Excellent combination gas and coal ranges are in the market for the use of

those who do not desire to be entirely without a coal stove and yet have no room for two stoves.

PARIS EXPOSITION.—Your Association has, through your President, received a communication from the "Sociétié Technique de l'Industrie du Gaz," calling attention to the meeting of the International Gas Congress in Paris, September 3d, 4th and 5th, 1900. I would suggest that a committee of three be appointed, with power to increase their number, to represent your Association at the Paris Exposition. I would suggest that they also be requested to submit a subject to be treated of by the Congress. "Electrolysis," "Gas Stoking Machinery," "Inclined Retorts," "Coke Ovens," "Gas Engines," and "Prepayment Meters," are all subjects which would be of great interest, treated of internationally.

In the spirit of the preamble likewise, your Secretary, Mr. N. W. Gifford, sent to each member a postal card, dated New Bedford, Mass., 9th month, 1899, a copy of which is appended as "Exhibit A." This was followed by a circular letter, signed by your President, dated January 20th, 1900, as in "Exhibit B."

Secretary Gifford followed this with his notice of February 1st, 1900, as in "Exhibit C."

The replies from members have been of assistance to Mr. Gifford and to me, and I desire to take this opportunity of acknowledging this and thanking the members for their assistance. The subject matter of this meeting has been influenced by expressed desires of one and another. Messrs. Allen, Goulding, Shelton and Waters have formal papers on subjects, two of which, while treated of previously, are not exhausted, and careful listening to all of these essays will be conducive to profitable discussion. Your particular attention is directed to the programme Mr. Gifford has prepared, if the notice in the AMERICAN GAS LIGHT JOURNAL has escaped your notice. Two "Topics" for general discussion have been provided:

1. Coke Oven and Retort House Construction and Results.
2. Under-Water Gas Main Construction.

The discussion on the first will be opened by Messrs. Hirt, Mayer, Ramsdell and Slater, Jr., which will draw out other volunteers, I hope. The second will be opened by Messrs. Coffin, Gould, Hirt and Slater, Sr., and I am sure will prove equally interesting.

I wish to express my appreciation of the interest displayed by the gentlemen not members who have consented to give you information they have, and that I am sure you will one and all profit by in the hearing. I wish to say that we should be considerate in our treatment of this information, and, in our thirst for more, not press them for more than they feel it is convenient to offer at this time.

I would be glad if any member desiring to speak, but not for publication, will indicate his wishes, which will be respected by the press represented.

It is a matter of deep regret that death has removed from us several of our members.

Hon. W. W. Greenough, former Treasurer of the Boston Gas Light Company, and first President of this Association. His name is as widely known as gas undertakings exist. He passed away June 17, 1899.

Mr. Gustavus E. Wetherbee, June 10, 1899, while Superintendent for the Roxbury Gas Light Company. He had been in various positions in the Roxbury, Boston and Worcester Companies.

Mr. L. P. Gerould, formerly of Nantucket, Mass., November 27, 1899. But lately retired from active management of any Company.

The appointment of committees to submit resolutions to the Association will doubtless receive attention. We are to be congratulated that, in spite of the serious illness of several of our members, they have recovered and are with us today. One of our Past Presidents, and one other member, I understand are seriously ill, and I hope a message of good cheer may be sent them. Mr. Taber was the President when I first joined this Association, and I shall remember with pleasure the cordial welcome he gave the new members.

Exhibit "A."

Office of the Secretary
New England Association of Gas Engineers.
New Bedford, Mass., 9th month, 1899.

Dear Sir: It is very much to be desired that future meetings of this Association shall be as interesting and helpful to members as those of the past. This will depend very much on the members themselves; and to make this so will you kindly

see if there is not something in your season's work which will be of interest to the other members, and which you can present at the next meeting in a "Paper," "Short Topic" or the "Question Box"?

Or, has there anything come to your notice which you would like to have discussed at the next meeting of the Association? And, if so, will you suggest some one as the author of such discussion?

Also, can you suggest the name of any who ought to be members of this Association, to whom application blanks may be sent?

Please give this your careful attention, and reply on attached postal card. Yours very truly,

N. W. GIFFORD, *Secretary*.

EXHIBIT "B."

BOSTON, MASS., Jan. 20th, 1900.

TO THE MEMBERS OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS:

Your Secretary, Mr. Gifford, has already written to the members in regard to papers and subjects that would interest the members. The replies received do not encourage us much, and I desire to again call the members' attention to the necessity of having some volunteers to insure the success of our annual meeting. You are earnestly requested to communicate with Mr. Gifford or me, if you can see your way clear to give the Association a paper on any subject that you believe would be suitable. Please do not lay this aside before at once communicating with Mr. Gifford or me.

This is a matter that, while of personal interest to Mr. Gifford and to me, is also particularly important for the welfare of your Association. Is it not your duty to help in some way? We are doing all we can, but need your help.

I am, very truly yours,

W. R. ADDICKS, *President*.

EXHIBIT "C."

The Council of the Société Technique de l'Industrie du Gaz en France has taken the initiative in proposing a reunion in an International Congress on the occasion of the Universal

[illegible] of 1900, of all the Societies similar to itself, and [illegible] persons who are interested in the progress of gas [illegible].

[illegible] Congress will be held in Paris, 1900, and very prob[illegible] the 3d, 4th and 5th of September, at the Exposition, [illegible] Hall of Congresses.

[illegible] seemed to us that a reunion of this nature could [illegible] results in bringing about an exchange of views upon [illegible] important points of the manufacture and utilization of [illegible] open questions which are attached to these [illegible].

[illegible] seemed to us all the more opportune because there has [illegible] up to the present, a Universal Congress devoted to [illegible] industry and it is to be hoped that this first reunion [illegible] a great interest. It will form, moreover, bonds of [illegible] and fraternity between all the representatives of our [illegible] which cannot help but be profitable to this industry [illegible] in this spirit that we come to invite your honor[illegible] to take part in this Congress.

We have thought that it was not necessary to fix as yet in [illegible] manner the programme of the transactions of the [illegible] but from now on we will busy ourselves in examin[illegible] number of questions which could be usefully [illegible] and we will be very much obliged to you if you would [illegible] to us those which you judge could appropriately [illegible] on the programme.

We will receive with gratitude all the observations and [illegible] which you will be kind enough to address to us.

[illegible] of Organization will afterwards fix and [illegible] definite programme of transactions, which will [illegible] technical questions, visits to the Exposition [illegible] works, a banquet offered by the Société [illegible] to all the members of the other Societies, [illegible]

[illegible] as we earnestly hope will be the case, you [illegible] to our appeal we will be very grateful if you [illegible] copies, and with the least possible delay, of [illegible] active members, which we will communicate to [illegible] Secretary's department of the Exposition, and, [illegible] or by our own, you will receive in ample

time the programme of the Congress, as well as the steps to be taken in order to join it."

COMMITTEE ON PRESIDENT'S ADDRESS.

The address was referred to a committee of three (Messrs. S. J. Fowler, C. D. Lamson and C. J. R. Humphreys), with instructions to report their consideration thereof at a later period.

The Secretary read the

ROLL CALL,

the following members responding to their names:

ACTIVE.

Addicks, W. R.	Boston, Mass.
Africa, W. G.	Manchester, N. H.
Alden, G. A.	Watertown, Mass.
Allen, B. J.	Allston, Mass.
Allyn, H. A.	East Cambridge, Mass.
Amory, Dr. R.	Boston, Mass.
Anderson, W.	East Boston, Mass.
Bartlett, L.	Cottage City, Mass.
Barnum, D. D.	Worcester, Mass.
Coffin, J. A.	Gloucester, Mass.
Coggeshall, H. F.	Fitchburg, Mass.
Cook, R. W.	Peekskill, N. Y.
Cooper, A. F.	Exeter, N. H.
Coyle, P.	Charlestown, Mass.
Crafts, H. C.	Northampton, Mass.
Davis, F. R.	Athol, Mass.
Fowler, S. J.	Springfield, Mass.
Gifford, N. W.	New Bedford, Mass.
Gould, J. A.	Boston, Mass.
Goulding, N. O.	Natick, Mass.
Harbison, J. P.	Hartford, Mass.
Hassett, E. J.	Beverly, Mass.
Humphreys, C. J. R.	Lawrence, Mass.
Humphreys, J. J., Jr.	Worcester, Mass.
Hurlburt, S.	Norwich, Conn.
Jenks, Z. M.	Woonsocket, R. I.
Jennings, F. W.	South Framingham, Mass.
Lamson, C. D.	Worcester, Mass.
Lane, H. M.	Leominster, Mass.
Leach, H. B.	Taunton, Mass.
Learned, E C.	New Britain, Conn.
Learned, W. A.	Newton, Mass.
Learned, C. A.	Meriden, Conn.
Lucey, F. J.	Natick, Mass.
Macmun, G. F.	Marlboro, Mass.
Manchester, G. L.	Easthampton, Mass.
Mansfield, G. W.	Salem, Mass.
McGregor, W.	Pawtucket, R. I.

McKay, W. E.	Boston, Mass.
Mooney, E. B.	Brockton, Mass.
Morrison, H. K.	Concord, N. H.
Moynahan, J. F.	Stoneham, Mass.
Neal, G. B.	Charlestown, Mass.
Nettleton, C. H	Derby, Conn.
Norton, H. A.	Boston, Mass.
Norton, W. F.	Nashua, N. H.
Norton, P. T.	Nashua, N. H.
Nute, J. E.	Fall River, Mass.
Nutting, C. H.	Chicopee, Mass.
Nutter, E. J.	Milford, Mass.
Parker, F. H.	Burlington, Vt.
Prichard, C. F.	Lynn, Mass.
Richardson, F. S	North Adams, Mass.
Rossman, G. M.	Keene, N. H,
Shelton, F. H.	Philadelphia, Pa.
Sherman, F. C.	New Haven, Conn.
Slater, A. B.	Providence, R. I.
Slater, A. B., Jr.	Providence, R. I.
Snow, W. H.	Holyoke, Mass.
Spaulding, C. F.	Waltham, Mass.
Spaulding, C. S.	Newburyport, Mass.
Spaulding, W. H	Westerly, R. I.
Stearns, W. M.	Waltham, Mass.
Stratton, W. K.	Haverhill, Mass.
Tilton, D. D.	Newburyport, Mass.
Todd, J. R.	Walnut Hill, Mass.
Willard, A. T.	Greenfield, Mass.
Wood, W. A.	Boston, Mass.
Woodward, R.	New Rochelle, N. Y.

ASSOCIATE.

Barnes, A. M.	Cambridge, Mass.
Browne, A. P.	Boston, Mass.
Coburn, C .M.	Chelsea, Mass.
Cortis, D. T	Boston, Mass.
Davis, F. J.	Waltham, Mass.
Hinman, C. W.	Charlestown, Mass.
Holmes, R. E	Winsted, Conn.
Homes, W.	Boston, Mass.
McKenney, W. A.	Boston, Mass.
Mace, F. W.	Lynn, Mass.
Scranton, G. H.	Derby, Conn.
Thomas, F. W.	Boston, Mass.
Tufts, J. P.	Boston, Mass.
Waldo, C. S	Boston, Mass.
Waldo, J. A.	Boston, Mass.

Appointment of Committees, Obituary Resolutions.

The President announced the following committees to prepare suitable mention respecting deceased members:

ON THE HON. W. W. GREENOUGH.— Messrs. C. D. Lamson, C. H. Nettleton and H. A. Allyn.

ON MR. GUSTAVUS WETHERBEE.— Messrs. J. A. Gould, Wm. Anderson and C. F. Spaulding.

ON MR. L. P. GEROULD.— Messrs. A. B. Slater, Jr., F. C. Sherman and H. B. Leach.

The President introduced Mr. F. H. Shelton, of Philadelphia, Pa., who read the following paper entitled

PUMPING GAS FIVE MILES AT TWENTY POUNDS PRESSURE.

MR. PRESIDENT AND GENTLEMEN OF THE ASSOCIATION: Last June I read a paper before the Western Gas Association, at its 22d annual meeting, in Milwaukee, entitled and advocating "Distributing Gas Under Higher Pressure."[1] I pointed out that steam, ammonia, air, oil, water, Pintsch gas, natural gas, and other fluids are daily safely distributed and handled in public places at many pounds pressure, in contrast with illuminating gas at but a few inches pressure (or but the fraction of one pound), and that the traditional practice of using but a zephyr-like pressure, involving large and costly pipes to send gas some distance, is relatively wasteful of energy and expensive, and, when analyzed, but little short of ridiculous. I contended that mechanical appliances, as well as precedents, were now sufficient to warrant distributing illuminating gas at several pounds pressure, and that such a plan of working should be and could be made entirely satisfactory, and would save enormously in the investment required. Since reading that paper, considerable further thought upon the matter has brought the settled conviction that transferring or distributing artificial gas at high pressure involves neither any great experiment nor any particular risk. An opportunity a short time ago presented itself to demonstrate my belief, despite the solicitous concern of several pessimistic friends, I assumed the responsibility of constructing a high pressure system. It has worked perfectly satisfactorily, and from the start. I have the pleasure of describing it herewith.

Phœnixville, Pennsylvania, 28 miles above Philadelphia, on the Schuylkill river, is a manufacturing town of 10,000 population. Spring City and Royersford, some 5 miles above it, are smaller towns adjoining, on opposite sides of the river,

1. See AM. GAS LIGHT JOURNAL, July 17, 1899, p. 84.

and together form a gas district of 6,000 people. In the intervening distance between it and Phœnixville there are a few farm houses, and a county almshouse about midway. Each district has had a gas company for many years. The plant at Phœnixville was fair; that at Royersford was wretched. The Consolidated Schuylkill Gas Company, organized by myself and associates, acquired October 1st, possession of both plants. It was decided to lay a high pressure connecting main from Phœnixville to Royersford, shut down the plant at the latter point and make all gas at Phœnixville. Work on the pipe line was started October 27th. Gas was pumped through within 64 days — Dec. 29th. Since that date, the Royersford district has continuously procured its gas from Phœnixville, without either trouble or the suggestion of trouble.

The connecting pipe line is 23,015 feet — or about $4\frac{1}{2}$ miles — in length, three-inch size, and, of course, of wrought iron. To protect against corrosion, it was suitably coated after being strung along the road, and recoated in part after joining in the trench. The pipe is heavier than the ordinary; special threaded connecting sockets were used, and provision was made for protecting threads in shipment from pipe mills to ditch. It is bedded $3\frac{1}{2}$ to 4 feet deep in natural earth from end to end. Two thousand feet of the run was through rock requiring blasting; 10,000 feet was through more or less shale and surface rock. Midway, it passes through an old-fashioned, covered, three-span wooden bridge, 600 feet long, crossing the Schuylkill river, being attached to the trusses 7 feet above the drive level. Certain weather casing was here provided. At one point, over a stone arch road bridge, the pipe has but 15 inches covering for a distance of 60 feet. It runs along a public highway throughout, excepting one stretch of 1,200 feet through fields, private ground. In its run it crosses under a three-track, trunk-line railroad. Valves are inserted at intervals, and adjoining the bridge, for use in the event of freshet or fire affecting the latter, and to facilitate the locating of any possible future leaks. Drips are provided. The run is fairly hilly. Some provision was made for contraction and expansion. As each 1,000 or 1,500 feet of pipe were added, the line was tested throughout with air pressure, from a power compressor at the works to 60 pounds. Despite all foresight and care, leaks were usually found. These were corrected, and a second test made, and not until the line stayed tight for

hours, was final filling in of the ditch permitted. When the line was finished, it was bottle-tight, end to end, as proven by 60 pounds test for hours. A wire was laid alongside in the trench from end to end, to enable the use in the future of any desired electric alarm, call bells, recording or signalling apparatus. A number of other construction details and adjuncts were incorporated, not necessary to here take up at length.

The pumping machinery at the starting point is a straight line, steam driven, air compressor of the usual type, but altered for handling gas. The steam and gas cylinders are each 8 inches by 12 inches, and the listed capacity at 140 revolutions of free air at atmospheric pressure is 5,820 cubic feet per hour, with a duty of indicated horse power of about 20. This compressor draws gas at ordinary pressure from the holder, a station meter, with by-pass intervening. It is located near the water gas apparatus, and is attended to by the gas maker. No extra labor is employed. The space occupied is about 2 feet by 8 feet, and its weight is slightly over 1 ton. Its cost, including governor, gauges, setting, freight, foundation, etc., was about $1,000. It is so run as to maintain 10 to 20 pounds pressure on the pipe line. Provision was made for adding a duplicate compressor. Gauges and other minor appurtenances were provided.

Principally because of quick delivery, two regulators or governors were used at the far end to reduce the pressure from the pipe line to the customary 2 or 3 inches. The first, with 3-inch connections, is built to reduce from 50 to 2 pounds. The second, with 6-inch connections, from 2 pounds to 2 inches. They are of the dry, non-freezing diaphragm type. They are relatively inexpensive and seemingly perfect in action. The gas after being reduced in pressure at the gas premises in Royersford, passes into a gas holder of 10,000 cubic feet capacity, from whence it passes into the street mains in the usual fashion. Connections are made, however, so as to enable by-passing the holder and the throwing of the governors directly on the town. The low pressure, 6-inch connections are sufficient for the present, but 8-inch will be a later size, and are partly in place. Suitable gauges, safety appliances and other features are covered in the valve room at the terminus of the line. The equipment within the room represents a cost of about $500. Taking this figure and the cost of a compressor as about the sum already given, plus the

cost of any given size pipe line laid per mile, one can approximate the cost of a complete high pressure installation.

As to operation: The gas handled is a straight illuminating water gas of 20 to 22-candle power, made from naptha on a machine of the Lowe type, but of bad design. The single superheater is smaller in diameter than the generator and the fixing surface scant. This will ultimately be corrected, but observations so far have been upon gas made on the machine as above. Each morning the gas maker at Phœnixville runs the compressor for about 2 hours and pumps enough gas up the valley to fill the holder at the Royersford works. Pumping then ceases, and the Royersford and Spring City supply is maintained from the local holder. About 5 o'clock it is nearly emptied and pumping is resumed and continued, until perhaps 8 o'clock, when the holder is left full for the night. Royersford signals Phœnixville when to start and when to stop pumping. The compressor is run at a rate of 25 per cent less than its listed speed and handles thus in practice about 4,000 feet per hour. This means a capacity of about 100,000 feet per day. This is at relatively low pressure. By increasing the speed and the pressure and alteration of governor adjustments, the pipe line can deliver much more in the future, when necessary. While pumping there is a loss of 2 to 3 pounds pressure at the far end, due to friction. Between periods of pumping, the pressure equalizes and is left on the pipe line, and in 8 to 12 hours over night it drops from 1 to 3 pounds. This is not pipe line leakage, but is due to the consumption of customers so far taken off the line, changes in temperature, slight condensation, difference in gauges, leakage aroued valve stems, etc. The cubic capacity of the line is about 1,200 feet.

The skeptics as to the success of the plan of handling — as herein described — illuminating gas at 20 pounds pressure told me there would be considerable loss of candle power from the compression, that the governors would not be reliable, that condensation would trouble us, that the high pressure in the pipe would be dangerous, that corrosion and leakage would shortly follow, and that breakdowns of the pumping machinery would imperil the general supply. We have been working now for nearly two months; we do not find the trouble predicted.

There is no visible difference in the candle power because of the compression and the long-distance delivery. The regu-

lators have not misbehaved a particle. We find them to be entirely reliable and dependable. The condensation is slight, is mostly caught at the beginning, and involves no trouble to take care of.

There are no signs of probable breakdowns. The compressor works as smoothly as could be desired. Duplicate parts in stock at moderate cost will enable the quick replacement of anything that is likely to break, as the holder at the far end gives at present a storage capacity sufficient to permit of changes, alterations, etc. When it is done away with, as is the expectation before long, a duplicate compressor will first be added, which can be started up in 30 seconds in the event of breakdown of the one operating.

We have no leakage on the pipe line, and its construction is such that we are certain that it will last for very many years before such occurs, or repairs or renewals of moment prove necessary. We are satisfied with it. We have not aimed to satisfy others.

The following points may be noted in connection with the general operation:

The amount of drip liquor taken out daily at the compressor, and at the first drip or two out on the line, is about 2 gallons. combustible and largely oil, but with some water in it. Drips examined half way along the line so far are practically dry. The amount of drip recovered is about 2 per cent. of the volume of the oil used in gas making. The temperature of the gas after compression and a couple of hours' operation, with 15 pounds pressure in the pipe line, was noted at 106°. At 20 pounds pressure it was 114°. The outside temperature was 40°. The temperature of the gas after emerging from the earth and passing through the regulators was 54° to 58°. It will be noted that no tank or cushion chamber is used at the outlet of the compressor. There is some pulsation while pumping at the beginning of the line, but no customers exist at that point.

Services along the pipe line where expected were provided for by tees. Additional services can be put in without shutting off the gas if desired.

In a second high-pressure line that will probably be installed shortly elsewhere, there will probably be used — for the sake of compactness — a single governor, instead of two as on the

line herein described, including increased provision for the occasional cleaning of same, as well as a line meter that will measure gas at 50 pounds pressure.

No photometrical observations have yet been made. We have been too busy with the completion of the line and other construction work to do aught else than get things finished and going in general. All of the figures mentioned in this paper are general and those so far observed, but they are felt to be practically correct.

We have just added midway a branch run of 2,000 feet of smaller high-pressure pipe to the County Almshouse mentioned, with which we will handle a business expected to amount to 500,000 cubic feet of gas in a year. Two house regulators at the far end of this run reduce the gas to the ordinary pressure and control the supply in the buildings, while a third regulator at the entrance of the Almshouse grounds controls a single lamp post. Each and all of these individual customers' service regulators are working as well as the main line regulators, cost but a few dollars each, and show the ease with which business can be taken care of en route on a high-pressure line. A firehouse has also been served by such a regulator for some weeks, and 17 houses on a cross street of 800 feet length are now being connected.

It will be noted that the work done by the above pipe line and compressor is substantially the economical transfer of gas from one holder to another a few miles apart. The two months' operation has demonstrated, satisfactorily to me, that we can pump gas at high-pressure, long distances, dependably as to both pumping and regulating mechanism, without trouble as to condensation, at low operating cost, without visible loss of candle power, and on a very low investment cost. I am expecting to further demonstrate that we can serve a town some miles distant with such an equipment *and without the use of a holder*. The regulators have so far worked perfectly on varying supplies and pressures in taking care of the gas passing through them into the holder, and there is no reason why they should not equally well handle and control the gas passing into the town direct. In fact we have already so operated, tentatively but continuously for 2 or 3 days, in preliminary trials and entirely successfully with the holder by-passed and entirely shut off, and we are expecting shortly, by a lengthy trial, to fully prove the last point to be covered, namely, that

a high pressure line, with continuous pumping at a moderate rate and duplicate compressors, will safely and dependably supply a town direct, and that no holder is necessary.

The long distance, high pressure delivery here described was started during a cold snap and involved a plan of working entirely new to the men in charge. The gas was made on an indifferent machine and was not overly well fixed. The reconstruction of the works at large to some extent interfered with attention to and concentration upon the pumping department. No station meters were then in use, and the steam supply for the entire gas works, water gas making, heating and all depended upon but a 30-horse power boiler. Despite the above everything worked as smoothly as could be desired, and that such should be so under such conditions, I take it, is some confirmation of my belief that pumping at high pressure can be readily done.

In view of the uniformly smooth working, and the satisfactory results experienced, there is no question in my mind that in most instances the cheapest way to transmit gas long distances will be found to be several pounds pressure through a very carefully laid small screw pipe. I and my associates are entirely satisfied with what we have done at Phœnixville on the lines described, and are expecting to shortly repeat it on a much larger scale in another and perhaps two other places.

While the pipe line here described is the first of which I have knowledge anywhere in which ordinary 22 candle power illuminating gas is handled at 20 pounds pressure, or thereabouts, it should be remembered that its successful working is but a confirmation of a closely similar operation that has for a long time been conducted by Mr. H. H. Edgerton, in Danbury, Conn., but which has practically been steadily overlooked or ignored by gas men at large. Mr. Edgerton, in pumping for nearly 10 years a 35 candle power, oil water gas 3 miles through a 2-inch main, and up to 40 pounds pressure, has long since shown the feasibility and low investment cost of supplying a town at a distance of high pressure. Credit for being the first to operate such a system should go to him.

The satisfactory operation of a high pressure line, I am well satisfied, will be closely dependent upon the attention paid to details. It may be thought that anyone can buy a pump, run a line of pipe, attach a regulator, and with such deliver gas at a distance. Anyone can try it, but I am certain

that, unless from 20 to 30 specific, definite details, of both construction and operation are sufficiently foreseen and provided for, the result will be but partially satisfactory.

A large part of the success of the Phœnixville line is directly due to the excellent work and care given to seemingly minor points, by Mr. B. S. Walters, the engineer in charge of construction, and I take pleasure in here giving him credit therefor.

Discussion.

The President — First I want to thank Mr. Shelton for the printed copies with which he favored us. They certainly have assisted us very much. I think we can congratulate Mr. Shelton that, notwithstanding this was new construction, he carried out the work so promptly. We are hardly surprised at this, because Mr. Shelton has shown us many times how to do things throughly, well and promptly. The discussion of the paper is before you. I am perfectly well aware, gentlemen, that there are comparatively few of us who are undertaking this work, but it certainly is a very interesting subject.

Mr. Anderson — Does Mr. Shelton consider it practical, with cast iron mains and cement joints, to get the effects of high pressure? Would they not have to be all wrought iron mains.

Mr. Shelton — I would not care to use cast pipe for many pounds pressure. I would not use anything but screw pipe on such a system, and properly protected against rust.

Mr. Nettleton — Mr. President, I think most of us hesitate to discuss the paper because we know so little about it. It is a new subject, but it is a very important one, and Mr. Shelton is to be congratulated on having broken the ice so successfully. If it is possible for us all to do as he has done, to make a 3-inch pipe do the same work as a 12-inch, it will be a great step in advance. I can't help feeling, however, that we will all be interested in knowing what the result is 3 or 5 years from now, after he has had some extremely cold weather and the frost has gotton down to his pipe. There is a possibility of leakage that is alarming to me, more alarming than is necessary perhaps, but if by any chance the frost should get down to that pipe and the gas should go out under 20 pounds pressure it might or might not do damage, but it certainly

would be a large loss. Undoubtedly by watching the matter carefully they would know at once when a leak started, but with frost three or four feet deep there would be a difficulty in locating the leak and in making the repairs, the town would probably be in darkness. That might or might not happen with a larger pipe. But as I sized the matter up off-hand it seems to me that the advantage is altogether with Mr. Shelton and this method. I would like to ask the coating that he put on the pipe, and whether in a case of this sort he has considered covering the wrought iron pipe with cement covering? I think all of you are familiar with what is known as the cement-lined water pipe that was quite popular in New England along in the sixties and early seventies. I have seen sections of this pipe perfectly preserved by cement after having been buried 25 years. I don't know that I can say any more, except to congratulate Mr. Shelton on the success he has reached, and I do that heartily.

Mr. C. F. Spaulding—Mr. Shelton, at what distance from the station did the pulsation of gas cease?

Mr. Shelton—About 2,000 or 3,000 feet; perhaps half a mile out of the $4\frac{1}{3}$ miles.

Mr. Fowler—In some mathematical calculations I made last year I found that the loss in carrying gases at these high pressures through pipes was pretty accurately calculated by using the general formulæ which we find in the books as the result of friction. To be sure, in my case it was carried out in steam, which is a gas resulting from the vaporization of water, but in carrying a certain amount of steam through a certain length of pipe of a certain diameter I found that the formulæ that we used for the ordinary circulation of illuminating gas was applicable to illuminating gas at these high pressures. That is, in other words, if anybody wants to find out the size of pipe he would require to carry gas a long distance at a high pressure, all he has to do is to take the formula that we use for carrying gas at low pressures.

Mr. C. J. R. Humphreys—I have been very much interested in Mr. Shelton's paper, and I think we are greatly indebted to him for bringing this matter to our attention. I would like to say a word in regard to house governors. Mr. Shelton's scheme, as I understand him, is not only to distribute gas under high pressure from one city or town to another, but he also

suggests the same plan as a possibility for distributing gas directly to the consumer; in fact, I believe he is doing so now, as I understand him. I would like to ask him if he has any fear of the house governor getting out of order and throwing the entire pressure on the house pipings and fixtures. I should also like to ask, if he has had such fear, whether he has been able to guard against it in any way.

Mr. McKay—I should like to learn from Mr. Shelton what was the provision to which he refers for the expansion and contraction of pipe, and whether any observation has been taken as to the movement of the pipe lineally in the trench under different conditions of temperature. Also, I would like to learn what he used in making the screw joints, and in what direction the thread is specialized; whether it is a finer thread or a longer thread or a more gradual taper.

The President—Perhaps some member has had experience in connection with Pintsch gas which would be somewhat similar on a smaller scale.

Mr. Barnum—I should like to ask Mr. Shelton if they have any trouble at the point where the pressure is reduced in the governor from 20 or 25 pounds, to the two or three ounces at which it is distributed. I should also like to ask him what the detail is of the drip for taking care of the condensation in the main line?

The President —We would like to hear from Mr. Nute, of Fall River, Mass., who, I understand, has had some experience in this direction.

Mr. Nute—My experience is very limited. It does not apply to gas through a main under 20 pounds pressure, but about one pound as a maximum, and then only for comparatively short times. We built a pusher plant last fall, connecting with several lines of mains going to outside districts. The mains were of cast iron, laid several years ago. They had become too small to supply the holders of the districts, which are entirely separate from the main works' district. The plant was built intending to run at about 15 inches pressure. As a matter of fact, the pressure we are frequently getting on those lines is 24 inches, or, rather somewhat in excess of 24 inches, for we find that a 24 inch gauge is blown out at times. The plant is working with perfect satisfaction. No difficulty whatever is experienced in any way. The result is to double the amount

of gas we formerly ever put into these outlying holders. Of course, one pound pressure is a very different thing from 20 pounds.

Mr. J. J. Humphreys, Jr. — Has Mr. Shelton noted a refrigerating effect at the reducing valve betweeen the high pressure line and the low pressure line and the amount of condensation at that point?

The President — Gentlemen, you have given Mr. Shelton a good many questions to answer, I know; but I think he is quite equal to all that you may ask him.

Mr. Prichard—The only objection that occurs to my mind is whether it would be advisable to carry pipes of this nature through a densely populated district, where there were high buildings and electric cars and sewers and the various things with which we have to contend in city distribution. I imagine, from the description Mr. Shelton gives, that his pipe is practically laid through the country, along a country road, and it occurs to me it would be interesting to know whether he would consider it advisable or safe to lay it through a city.

Mr. W. A. Learned—Mr. Prichard's remarks lead me to ask whether, in Western cities, the natural gas companies are regulated by ordinance as to the pressure they carry on their street mains.

The President —It might be interesting in that direction if Mr. Shelton could tell us whether the natural gas companies are using holders now on their mains, depending on holder pressure. I presume that would come in the question. I don't see any other members rising, so Mr. Shelton we will give you the opportunity to answer the questions which have been asked.

Mr. Shelton—I am very glad to be able to give my ideas for what they are worth on the different points that have been suggested, and on the questions that have been asked. In answer to Mr. Nettleton's suggestion, as to the effect of frost, I would say that the principal reason why we have not worried about what frost would do on our pipes, 3 or 4 feet underground, is because at Danbury, with a 2-inch pipe that has been there for 10 years, they have had no material trouble on that score. That exceeds Mr. Nettleton's time of 3 to 5 years! Their satisfaction and their freedom from trouble of any

moment in that direction were the reasons that made me feel that, if the pipe was well laid, and some provision was made, as far as possible, for contraction and expansion, so that there would be the least tendency to pull apart on the threads, we would have no real trouble that way. I would like to say right here that a large part of our warrant for kicking over a little bit of tradition, and for leaving the rut and going into a departure in the way of distributing gas at high pressure, was because of the everyday, ordinary, day-in-and-day-out success and freedom from trouble of Mr. Edgerton's Danbury installation. We have not—I say "we," I mean gas men at large, all of us—I think appreciated what he has been quietly demonstrating there. We have not happened to come across it. We have not happened to observe it. We have had no connection with it particularly. We have not quite realized that he has found it cheap and satisfactory to distribute gas at a considerable distance, and has been doing it for so long a time that the Superintendent and others there very frankly say they do not give any thought to it; they have done it so long they have ceased to think of it; the novelty has long since disappeared. Their pipe line was poorly laid; they frankly said so. They had to correct a little of it. At times they had to go over it more or less. We have profited by their caution and put in our pipe line with exceptional care. I am proud of the work that our men have put into that construction, and I believe, from the way it has been built and from the precedent of Danbury, that we will have no trouble at all from frost. We have been through three cold spells since it has been laid, under operation with gas; we have had no suggestion of rupture or break or trouble so far, and are not looking for it. So far as the coating is concerned, in this particular instance we used a coating that was made in Cincinnati, but not General Hickenlooper's. It comes in convenient barrel form, and has served us satisfactorily in some other work. It seemed very hard, very durable and easy to handle, and we concluded to continue our use of it in connection with this pipe line. On the question of house governors, which Mr. Humphreys asked about, I do not think we are taking any material risk in putting in cast iron governors in the cellars of houses, for the reason that the natural gas people worked that all out for us, in my belief. Ten years ago, 12 or 15 years ago, when natural gas was first brought into the different cities in the

West, we recollect hearing about a great many natural gas explosions. The natural gas companies had to work through their preliminary period of how to handle high pressure, had to find out what appliances were necessary and how to construct them, how to make them stand up to their work. They have been doing that year in and year out for the last 10 years. The natural gas country is now full of appliances for handling, measuring and controlling high pressure gas, that we do not appreciate at all because we, at low pressure, have had no occasion to look into the line of appliances that are on the market in the Pittsburg centre, and in Indiana more particularly. There are governors there that will do practically any work you want them to. The house regulators are most perfect pieces of mechanism. The ones that we use we transplanted bodily from the natural gas people. We did not have to invent them or design them or work them out; we simply appropriated what had been worked out in the first place and "annexed" them. They cut down from 10 to 20 pounds of pressure on the one side to 17-tenths on the low side at one operation. There is not a variation of 1 tenth of an inch, whether one burner be turned on or 50 burners. Pittsburg is full of them. I may say that the majority of the Welsbach business is done in Pittsburg from natural gas at a few pounds pressure in the street through one of these governors to 17 tenths pressure inside of houses. That is the standard pressure at which the regulators are set at the meter, and they work perfectly. Probably there are thousands and thousands of those regulators in use in the cellars at Pittsburg, and they have no more trouble from them than from an ordinary cock or any other standard piece of mechanism. They do not begin to have the trouble they do with meters. They do not get out of adjustment as easily; they do not have the repair expense that meters have. They are so constructed that if anything goes wrong the pressure is not thrown on the meter and on the house pipes. They differ in their different makes as to their design and action on this point. Some of them go to the point that if anything goes wrong, any excess gas passes through a pipe out into the open. If any possible event of gas getting by the diaphragm or by the governor it will not get into the cellar or the building, but goes back into the atmosphere, through a $\frac{3}{8}$ pipe from a vent in the top of the governor back through the hole in the wall that the service

pipe comes in, only a distance of 3 or 4 feet. It is so easily covered that one pattern of governor has rather taken that up as its way of meeting any possible objection on that score. My feeling is that if Pittsburg and Indianapolis and Muncie, and all the other natural gas towns in the West, can use these devices by the thousand, not only scores and hundreds, but thousands and probably scores of thousands, between the nearest and the farthest confines of the natural gas region, they can be used with equal safety in handling an articificial gas, if we should see fit to pump up the pressure of that to a few pounds instead of a few ounces. I do not think we are taking any material risk in using such appliances. The demonstration has been made on natural gas. We are simply copying and doing what has been done for years there. On the question of contraction and expansion, that Mr. McKay asks about, I would rather tell him outside just how we covered that point. The sockets were special, in the sense that they brought the pipe ends butt to butt and had more of a taper than the ordinary socket, so that when the threads were made up with chain tongs, with a piece of pipe stuck over them and three men pulling on it, there was very little question but that those sockets were tight—much more likely to be tight than the ordinary socket. In answer to the inquiry as to trouble at the governor, I stated, I think, most clearly in my paper, and I cannot make it any more complete, that the governors have been simply perfect. We have not had any suggestion of trouble. They were put in, set, regulated a little bit as we thought about right, and have been operating the same way ever since. We have adjusted them a few times up and down, in experimenting as to pressures locally, but as far as their record is concerned it is perfect. As to the drip found at those governors: We take out of the governors a little lubricating oil that is put in them, and nothing else.

The drip (the condensation from compressing the gas) is caught at the beginning of the pipe line, and does not deposit out along the pipe line. We made provision for drips at every low point. There was a little delay in getting them, and, as a matter of fact, we only put in drips on the first 3,000 feet. Openings were left on the balance of the 4 miles of pipe, but there are no drips. We find that all the condensation due to compression is caught around the pump and at the first drips, a few hundred feet out on the line. In opening a pipe to

make a connection to the county almshouse, midway in the line, after a month or six weeks' operation the pipe was as dry as a bone; no evidence of moisture, and that was at a low point. There is no evidence of moisture at any place throughout the line, beyond the initial drips that I spoke of. We find no "refrigeration" at the governors. In theory there should be such — probably it is there if we should endeavor to determine it exactly, but there has not been enough to be particularly noticeable, certainly not enough to bother us in any way, and we have substantially ignored any cooling that comes to the gas from the expansion. The rate of expansion is comparatively moderate, and there is more or less metal work about, and I presume the cold is absorbed in such a way that it is not particularly in evidence. In regard to the distribution of natural gas under pressure in the Western towns that Mr. Learned asked about, I have not posted myself particularly as to exactly the condition, but I am under the very strong impression (and perhaps some of the members who have recently been West — I am looking at Mr. Ramsdell just now — and have travelled in that region more or less, may be able to correct me or to advise) that the natural gas is brought, of course, across country, ordinarily speaking, at 100 or 200 pounds pressure, whatever it may be, and then that city ordiances compel in most cases its reduction at the city limits to what is called a low pressure service, which low pressure is, I believe, from 5 to 7 or 10 pounds, along in that range. If that is so, and I believe it is so (I know it is in some cities,) then the natural gas people are distributing in wrought iron pipes (that Mr. Prichard asked the propriety of) an explosive, inflammable substance, *i. e.*, gas, under a number of pounds pressure, and a gas which has but comparatively little odor, if any, in the event of leakage. That is all that I propose to do in distributing illuminating gas at a few pounds pressure, 5, 10, 15, 20, or along in that range; and I think we would find in doing it that we would be taking no more material risk than the natural gas people today are safely doing in hundreds of cities, in the States commencing with Pennsylvania and westward.

If they can put in wrought iron pipes over and under and around and about sewers and water pipes, conduits, trolley systems and everything else that is found in the principal cities, and if they, as in Buffalo and Pittsburg, Alleghany, Columbus,

Detroit, Indianapolis and every principal city that you can think of almost in the middle West, can safely distribute an explosive, inflammable stuff through wrought iron pipes, as they do, without enough trouble or accident or "come-backs" to make a hue or cry or furore, but do it daily with ordinary success and general satisfaction on their own part, and the part of the public as well, we certainly are not doing anything involving any *more* risk, in my judgment, in doing exactly the same thing with artificial gas instead of natural gas. My belief is that the whole thing resolves down to simply the proposition:

"Why cannot we do with Artificial Gas exactly what is being done with Natural Gas, and has been done with Natural Gas safely and satisfactorily, for quite a number of years?"

Can we not do that, and do it at very much less expense, than we are now delivering our product? It seems to me there is room for a heap of cogitation on that point. It is what I think we are gradually demonstrating with this little plant at Royersford, Pa., and which will be further demonstrated probably the coming season, by two other installations of that nature. We have used a gas holder there for the present because we had it. It was not necessary to take any more risk with a new plan of working than we had to take. The holder was there. We connected it up; but a short time ago we cut it off and by-passed it to see how the town would behave without it. There was no difference in the results at all. There was no logical reason why there should be any difference. The governors do not care, so to speak, whether they are working against a holder or against a town—they are simply throttling a certain pressure; and if they will dependably do that one does not need a holder, in my judgment. I believe that provision should be made for the duplication of those governors, for cleaning, for getting out of repair. No piece of machinery can be depended upon to work forever, or without needing attention some time. Fortunately, however, for high pressure installations, both the pumping mechanism and the reducing mechanism at the far end are exceedingly cheap in relation to the work that they do. You get a governor for $100 or $150. You can duplicate that governor

and have the two side by side in the same box at a trifling expense. The interest on that additional investment is practically nothing a year. In doing that one has perfect provision for attending to one governor, cleaning it, or repairing it, if it gets out of order, and by the use of such governors, first one week and then the other, the two alternating, one positively knows that the mechanism at all times is in working order. The same applies to the compressor. With duplicate compressors the pressure in a pipe line will carry itself for a few minutes, half an hour or an hour perhaps, before the public get out of gas, because of the gas stored in the line. Well, within that time, within a minute's time in the event of accident, one could easily start up the other compressor. The Pintsch people do that in several places where they supply a railroad service, where the complaint in the event of shut down is quite as as emphatic as any complaint that we are likely to receive. They never stop delivering from one year's end to the other. If they can do it we can do it.

The President — Gentlemen, as I understand the rules of the Association, after a discussion is closed and reply is made it is not usual to call on anyone else. Mr. Shelton, however, has mentioned Mr. Ramsdell's name, and I am sure we will be glad, if Mr. Ramsdel cares to say anything, to hear from him, of course with the provision that Mr. Shelton has a reply if he wishes it. Mr. Ramsdell, do you care to say anything?

Mr. Ramsdell — I might possibly give some information regarding the question asked about natural gas, having had some experience in two towns in competition with companies that distributed natural gas where our company owned plants. My general impression is that in former times the natural gas companies were very indifferent to governors or other things of that sort. Their pipes were probably laid in haste, and the full pressure of the wells was put on the pipe up to the time that it reached the community which it was to serve. As a factor of safety, however, the communities supplied resorted to ordinances which compelled the natural gas people to reduce their pressure to what was considered a safe limit. I think this pressure is usually 5 pounds, and in a great many instances the pressure in the house was at that figure, but the friction in pipes through the towns as a rule reduced it so that probably about 2 pounds would be the average in the houses.

They found a great deal of difficulty in using Welsbach lamps under this pressure, and, as most of you know, the Welsbach Company got out a special mantle, which was called the natural gas mantle. I do not remember its number, but it never gave as good a light as did the Welsbach No. 169 until somebody out in that territory was shrewd enough to invent a little governor, placed on the burner underneath the mantle, which ended all that trouble. So that they can now use the No. 169 just as we do, and you can scarcely tell one from the other. Recently the natural gas companies themselves have had to resort to all sorts of plans and schemes to retain their gas themselves, in order to give a sufficient supply for the demand, so that they have gotten up all of these forms of apparatus of which Mr. Shelton speaks. They have very perfect governor systems, and everything possible is now done to keep up their supply. They have great difficulty, of course. in midwinter, so that it is necessary for them to do this. In fact, they now go so far as to meter the gas in a great part of that country, where formerly they did not do anything in that line. As to the use of holders, I think such impression arises from the fact that one of the principal natural gas companies in the west has within recent years purchased a good many illuminating gas plants, and in such instances they are generally accused of putting their natural gas in holders, enriching it and selling it in our way. I don't think they do this. I don't think they use holders at all. They simply depend on the pressure from the wells for their supply.

Mr. Harbison moved (seconded by Mr. McGregor) a vote of thanks to Mr. Shelton. In announcing the result, the President said: Mr. Shelton, it gives me great pleasure to give you the thanks of the Association for this paper. We are very much indebted to you for bringing before us a new subject, and we hope that further experience will bring forth another paper in which you can answer certain questions. We thank you, sir.

The President having made some announcements respecting routine matters, asked the Secretary to read the paper by Mr. John A. Waters, of Stamford, Conn., as the author was unable to be present at the meeting. Secretary Gifford read the paper, the title of which was

THEN, NOW AND LATER.

Lest we forget the past and the lessons taught, the writer requests the members to go back with him over some of the more important experiences of years gone by, that our memories may be refreshed, and that in recurring the more vividly may appear the striking dissimilarity of theories and practices directly connected with gas manufacture, "Then and Now;" and, noting the progress made and success achieved, we may consistently and without overdrawing our imagination foresee changed conditions "Later."

In reverting to early practices in water gas manufacture, and comparing results then with results obtained now, we are reminded forcibly of the fact that the reduced cost of gas in holder (per material used) is not entirely due to improvements in apparatus. To improved operations in handling apparatus we must certainly attribute, in a measure, some of our success.

Then, a long blow, and in many cases where pressure blowers were in use, a "strong blow" was thought to be the one essential necessary to the obtaining of incandesence in the generator and the proper degree of heat in superheater; the time of blasting up extending from 20 to 45 minutes, the gas making period being correspondingly lengthy or more so, inasmuch as it ranged from 20 minutes to an even hour. The temperature of superheater was considered of the greatest importance, in that (and this was the theory as it was understood then) the olefiant gases commingling in the superheater with hydrogen should be subjected to a much higher temperature than that at which they were generated, in order that they might be made "homogeneous." You remember the word. We heard it often and used it familiarly, therefore, in practice the eye of the gas maker, that pyrometer of gas manufacture, was accustomed to a bright orange tint, and continued his blow until that color in heat appeared, when conditions were proper for a run. What mattered if in the early portion thereof a certain amount of carburetting material was decomposed and lamp black formed? What mattered the quality of product for 5, yes, 10 minutes? The make during this interval was rapid, astonishingly so, and although "thin" it was thought the carrier and supporter of the rich gases to follow later. And it was true; the gas delivered from the holder was uniform in candle power, and, on the whole, satisfactory. So why bother with

[illegible] Water gas was being produced cheaper [illegible] and had come to stay. Economy of production [illegible] considered except in its relation to coal gas. [illegible] take-off pipes, seal and scrubbers very [illegible] thought an almost unavoidable accompaniment [illegible] make. 'Tis true we sought to avoid this [illegible] ways, but with only partial success. It is [illegible] small take off connections and local conditions [illegible] with choking of apparatus. If the [illegible] and clinkers were an annoyance, we had [illegible] hammers to help relieve us. Checker-work in [illegible] still another cause for perplexity, it fouled [illegible] remember, had to be removed and replaced [illegible] at top. Yet withal water gas was [illegible] we were charitably inclined. As its use be- [illegible] bringing with it the experience of others, [illegible] economy of production became man- [illegible] engineers hitherto declined to have to do [illegible] for discussion in the meetings of the [illegible] new adherents came new ideas. Gradually [illegible] understanding that condition not theory con-

[illegible] high secondary heating of our car- [illegible] necessary to the avoidance of loss of [illegible] and condensation, bethought of tem- [illegible] our coal retorts and oil benches, and, [illegible] convinced that we had gone to the ex- [illegible] fixing process. A lower temperature [illegible] was then thought the necessity, and in- [illegible] the form of the double-superheater [illegible] because of the faults of the short super- [illegible] the use of the higher priced naphtha [illegible] and the low priced crude oil substituted [illegible] improvement presented. The use of [illegible] also gave to us the first actual improve- [illegible] low grade crude oil was used with satis- [illegible] however, because of the extended gauntlet [illegible] through which the gases had to pass, but [illegible] which the middle chamber per- [illegible] liquid material used. It was no longer [illegible] incandescence on the surface of the coal in [illegible] oil injected thereon might give forth its

vapor, consequently waste of fuel in the reheating was reduced. The period of "blast" and "run" became shorter. Water gas making was being understood. A few years elapse and present day practices are before us.

We who thought a gradually increasing heat from carburetor to superheater outlet of utmost importance then, are inclined to almost reversed conditions now. High pressure blowing, which was thought the main factor in attaining heating effect, of our generator gases then, has given place to moderate pressures, and *producer gas of value* is the result now.

The writer has recurred to a few changes in operative methods. It is fair to assume, in view of the benefit derived, that they have had much to do with economy in production; but it would not be fair to infer that this is the direct cause or effect of our progress. Without the various improvements in apparatus of recent years to assist us, present day results would not have been obtained.

Only one ruffle appears on the otherwise placid surface of the later manufacture of water gas, and, queerly enough, oil is the element through which and by which the surface may be smoothed. Without entering into or questioning the wisdom of the course pursued by our suppliers of enriching material, the fact remains, and is painfully apparent, that the increase in price of their staple has brought us face to face with a problem we must confess we had not thought of. It is a problem which deserves of the consideration of all, irrespective of whether we have water or coal gas plants in our care. It has been asserted that the solution or remedy for this present difficulty is in the curtailing or reduction of water gas produced, and that our product be composed of equal portions of each. Output of works must certainly be taken to account, in considering the above proposition. To work to advantage in either respect the make must be near the capacity of benches under fire, or the particular set of apparatus used.

The construction of coal gas benches will not allow of the intermittent firing up and letting down, and to maintain heats while retorts were inactive would be the height of wasteful folly. Many of us no doubt are hesitating, and with reason, as to the proper course to pursue. We remember and reflect on the incentives which compelled us to abandon the manufacture of coal gas (universal then) and install water gas in

its place. Memory brings back the prettily persuasive arguments of water gas projectors. You remember the period. Our tar wells were filled to overflowing and flowing over. Our coke shed was filled to its capacity, and we were ready to welcome any relief which offered towards the abatement of our "tar nuisance" and the reduction of our coke pile. We became enamored, and were converted. And now in the light of our experiences then the question arises: "Will the same conditions prevail later?" Who can answer? The doctrine of supply and demand must govern. Tar wells are overflowing now as then. You may say that location of works is the probable cause of this. Should location affect the sale of any article really in demand? and we answer in good faith, "No."

If the manufacture of coal gas should be taken up to the exclusion of water gas, would it not mean overproduction of the principal products, the *sale* of which pertain to the reducing of cost. We answer again in good faith, "It would."

There is cause for alarm in water gas manufacture we acknowledge, but we have not satisfied ourselves in regard to the minimum cost of producing. We remember then. Compared with coal gas it is as youth to old age. It has had a rapid and healthy growth, and has not yet reached the settling down point. Much more is expected than we have received. Improvements have followed its "growing up," each in turn adding to its strength. On the contrary, although improvements have been made in coal benches, the yield per pound of coal used was practically the same, then as now. In conclusion, therefore, to compensate as it were for the labor and coal items, so largely important to the make up of coal gas, by-products must of necessity become more valuable before it will stand alone. To venture a prophecy — it is within the scope of this paper — the flexible apparatus will come, making possible the producing of the old and the new, either or both, as required. One unit, two products. Mixed, the gas of later.

Discussion.

The President. — Gentlemen, I am sorry that Mr. Waters is not here to hear your approval as expressed by the applause. It is a matter of very great interest, looking back to the times 30 or 40 years ago (possibly this paper does not go that far back, and I do not propose to go that far back in my own

memory) to have these facts noted for us to pick up the threads and see what has been. It is very valuable to us when, turning over the problems in our own minds in preventing us from unconsciously, possibly, taking up something that has been, and getting that same experience over again. I am sorry I did not know the contents of this paper, as I picked up some old proceedings of the seventies a few days ago. I had intended referring to it in my presidential address, but I felt that I was tiring you as it was, so I left it out. But $12 a ton for coke was very attractive. It was not quite so attractive to hear that you paid $12 a ton for coal, but the prices of gas were exceedingly attractive compared with the present condition. I won't mention them, because I don't want to turn your minds backward quite so far. Gentlemen, the paper now is before you, and I am sure Mr. Waters would be glad of expressions from the members on it, and if he comes tomorrow we will ask you to repeat any apt questions that may be asked. I might say that Mr. Waters might be privileged to reply through the JOURNAL. I presume that would be a proper way.

OPENING OF THE QUESTION BOX.

The President.—If there is no objection to going out of the regular order, and as we have but 15 minutes before recess, I suggest that the Question Box be opened. The first question was one that we hoped Capt. W. H. White would reply to, but the Captain unfortunately was called away. The question is:

"What successful substitute for cast iron gas mains has the high price of iron developed?"

Mr. McGregor.—I think Mr. Shelton answered that question very well.

The President.—I think that reply is very apt.

The Secretary—I would like to say that I have had my feelings very much hurt in the treatment of questions that I have put into the Question Box in other Associations than this, and I sincerely hope the New England Association will treat the questions with courtesy and consideration. I think most of the questions are put in in good faith. Certainly, if I put in a question and it was treated with levity, I should feel hurt officially and personally. I hope this Association will treat

the questions from the Question Box with all the consideration which they deserve.

Mr. Shelton. — The Secretary appears to have been suddenly hit by something, and as he seems to feel that the comment made on that question so far has been possibly not very relevant or quite fair to it, I will try and add a little to the discussion, simply as a matter of record. I do not know of any substitute for cast iron pipe that has been actually used to any extent. In the past year I have had occasion to look into it quite a little and I have not found anything that I felt warranted by precedent and the use of others or by my own conclusion in thinking would justify my departing from either cast or wrought iron. The price of wrought iron has not been any relief from the price of cast iron; if anything, it has been worse. Mr. Butterworth, of Columbus, O., proposed at the Western meeting last year the use of terra cotta pipe, or Mr. Doherty, I forget which. I do not understand that any installation of that has been put in, or that any information is available as to how such stands up to its duty under actual work. In Philadelphia, about a year ago, a glass pipe was advertised quite freely, and its strength and cost were promised as being respectively equal to and somewhat less than cast iron at $20 to $25 a ton. I think it had some very attractive features, especially as against electrolysis, but it never got beyond the point of the prospectus. It has not materialized. A good many of us in that neighborhood wish that it would materialize, as the machinery designed for making it was very attractive and complete, and promised to turn it out really at low figures. Mr. Nettleton spoke a short time ago of a wrought iron pipe covered with cement for use by water companies. I might add that in Philadelphia, at least in that neighborhood, is a concern that makes very considerable quantities of that pipe, and it is used by them for their own associated water works almost entirely. They are not in the gas business to any extent, and I do not understand that it has been used outside of water, but as a practical, everyday substitute for cast iron pipe, for such use it is certainly something that has been used to a large extent, and is doing the work first rate. They take a sheet of wrought iron, about an eighth of an inch thick, roll it into pipe form, line it inside with cement, so that the sheet iron is absolutely protected, as far as corrosion is concerned,

both inside and out. They then cover the outside coating of cement with a final coating of thin iron, which is simply for appearances and to protect the cement in shipment. They expect that the thin sheet iron coating will shortly rust off in the ground and leave the solid cement, which they are depending on as against corrosion, and the wrought iron within, which they are depending upon for strength. That pipe has been used in the instance of scores of miles very satisfactorily in water, and it seems to be a good substitute for cast iron in that business. I have yet to learn of its being tried in gas.

Mr. Mansfield— The coated pipe that Mr. Shelton speaks of is a vast improvement over the original cement pipe with the single coating of iron outside of it. I have seen the two used together frequently. Take the pipe that has a single coating of cement inside, with a single layer of sheet iron outside. If when that is laid there is any break in the cement or the cement is anyways porous, in a very short time the iron will pit so badly that it will begin to leak to a greater or lesser extent. But this pipe that Mr. Shelton speaks of, even if when it is laid it is not so carefully coated, will last very much longer than the original type of cement pipe with a single coating of iron outside of it. Those who have at least 30 years' experience in the use of it claim it depends entirely on the outer coating of cement finally given to it when laid in the ground.

Mr. Coggeshall— I was in Nyack, N. Y., three or four years ago where they were laying wood pipe, prepared by some wood impregnation process, and they had a guarantee of 10 years from the pipe manufacturers. I had some correspondence with the manufacturers of the pipe as to the guarantee. I am pretty conservative, I never used any of it; but they were using wood pipe in laying gas mains in Nyack at that time.

Mr. Nute— I had a little experience about 12 years ago with the pipe Mr. Shelton speaks of in the use for gas. We laid, as I recall now, about a quarter of a mile of 10 inch main in this service. The company sent on an expert to see that it was properly laid. The pipe leaked from the time it was put down, in fact the leakage was considerable. It continued to leak worse and worse, until, a very few years afterwards, it was taken up and replaced with cast iron pipe.

... that such pipe is successfully used for ... in that case that we could use it for gas.

... —Joint leaked, or pipe leaked?

... Both. They did not make the joints tight or ... the pipe. It leaked at intervals along the ...

... —It is only fair to the pipe to say that this ... improved since, because I know that that *pipe* ... whatever the joint may do.

... —I want to suggest a possible explanation. ... pipe, valve or apparatus of that kind with ... it tight and then test it for gas you will find it ... leakage. If you made the original test at your ... air. I think you might find that pipe leaked, where ... not find it so in the case of a test with water.

... —I would like to inquire of Mr. Shelton ... joints of the pipe to which he alludes are of the ... sleeve type?

... —It is substantially with a coupling or sleeve, ... the joint, and made up with cement on the lines of ... joints; a sleeve that laps the two ends of the pipe ...

... —I was fortunate enough to see a 40 inch ... pipe filled with water last summer, and I happened to ... joint that was uncovered. When they were filling it ... of air came out, which would have come out of a leak ... gas pipe, with a few inches of water pressure, but when the water came it was absolutely tight.

The President—That is an interesting statement. Now, gentlemen, we are within five minutes of the recess hour, and I don't want to keep any of the members from the necessary time for dinner. I would say that it is proposed, unless any members make suggestions to effect the decision, that immediately after the reassembling, the topic of "Oven and Retort House Construction and Results" will be taken up. Will you kindly bear this in mind?

A recess was ordered to terminate 2.30 P. M.

FIRST DAY — AFTERNOON SESSION.

The Association reassembled at 2.30 P. M. The President called for reports of committees.

Mr. C. F. Prichard submitted the following

REPORT OF COMMITEE ON NOMINATIONS.

Your Committee on Nominations would respectfully report the following names for office bearers for the ensuing year:

President — Walter R. Addicks, Boston, Mass.

First Vice President — Waldo A. Learned, Newton, Mass.

Second Vice President — Wm. E. McKay, Boston, Mass.

Secretary and Treasurer — N. W. Gifford, New Bedford, Mass.

Directors — F. S. Richardson, W. G. Africa, William McGregor, Joseph E. Nute and Wm. H. Snow.

ELECTION OF OFFICERS.

On motion of Mr. Neal the report of the committee was accepted, and, on motion of Mr. Slater, Mr. H. B. Leach was named to cast the ballot of the Association in favor of the election to office of the gentlemen named.

Mr. Leach cast the ballot as directed, and reported the result.

The President in declaring the election said: Gentlemen — I would have been very glad to have gone on and surrendered the position to my successor. I have to say, however, that I appreciate the compliment of a re-election, and I thank you for it. [Applause.] We will now take up the subject for discussion announced before recess, the short topic

OVEN AND RETORT HOUSE CONSTRUCTION AND RESULTS,

and I will ask Mr. Louis J. Hirt, Chief Engineer of the New England Gas and Coke Company, and of the Massachusetts Pipe Line Company, to open this discussion.

Mr. Hirt — Mr. President and gentlemen of the New England Association: I thought the best way to open a discussion was to put it on paper. If you had asked me to do that a year ago I would have had to speak about anticipations, but

today, I am pleased to state I can show you some results. Those who are acquainted with our works know now that about seven-eighths of it is running, and we expect to have it in full operation by the 1st of March. In this paper I assume you all understand the general arrangement of our works, and am not giving a description thereof, but merely trying to compare it with the ordinary, plain, everyday gas works; or, better yet, with the through retorts.

The general construction of the Otto coke ovens differ but very little from the through retort coal gas construction, especially where liquid or gaseous fuels are used for heating the retorts. The ordinary through retort has a capacity to accommodate a charge of 600 pounds, while the Otto coke ovens [referring to those at Everett] have a capacity to carbonize six tons of coal at one charge. Once the coal is in the ovens the operation is practically the same, and differs only in what is the essential points to us—namely, to make a heavier or more dense coke than it is possible to make in the ordinary coal gas retort. In the through retort the coal body averages not over 9 inches in thickness. The heat can attack it from the four sides; namely, the bottom, two sides and the top. If it is a D shaped retort, it may be said that the heat attacks it at all points at once. Therefore the action of the heat, being practically the same at any point radiant from the center of the mass of coal, the quantity of coal fluxed at the same time is nearly the whole amount of the section of the layer of coal in the retort. The lighter hydrocarbons are expelled in a much shorter period of time where the coal is attacked by the heat in such a manner. The effect of this action is to produce a very spongy, soft coke. While the penetration of the heat in the vertical Otto retort is similar to the through retort, the action of it on this large mass of coal is much slower. The side walls being proportionately larger in area than on the bottom or top, the action of the heat [especially due to the way the heating of the flues of the ovens are constructed] takes place mostly from the side, and the coal is almost entirely carbonized from the two vertical sides. The heat fluxes the coal next to the wall first, then forms the first cells, and as the action of melting the coal creeps in towards the center of the mass, in steps, averaging about one inch in depth—and as long as there is fresh coal ahead of the fluxing part—the fluxed coal is more dense and is a heavier, plastic

substance, and stays so as long as there is fresh coal ahead to supply the flux; but the moment the fluxed parts meet in the center the remaining inch or inch and a half of the coal when coked becomes of a spongy nature and makes a fac-simile structural coke to that made in the ordinary gas retort. Carbonizing the coal in this slower manner clearly demonstrates that there must be a greater amount of carbon left in the coke, it being much denser, and of course evolving a smaller amount of rich gas per ton of coal than is done in the ordinary gas retort.

The application of the heat to the Otto retorts is very similar to the latest designs of the through retorts, and the only difference in heating effect can be the thickness of the walls. In our case the walls are 3½ inches thick, through which the heat has to penetrate to attack the coal, while in the through retort it seldom exceeds 2½ inches, and as tests have not been made to show the exact results, and though there may be admitted a slight disadvantage to the thicker walls, I think it is offset with the less expense the coke oven plant has in the handling of the material over the through retort, and that this more than compensates for the slight difference in heat efficiency. Our retorts take a charge of 6 tons of coal, and the construction of the Otto ovens allows us to charge the retorts from above. The average time to charge and discharge an oven is 10 minutes. Of this 4 minutes are allowed for the pushing of the coke, 1 minute for the closing of the doors, 2 minutes for the charging of coal, and 3 minutes for leveling.

The average charging time in a gas works having Otto retorts is about 10 times less than the best retort practice, using equal quantities of coal. Once charged these ovens will remain undisturbed from 26 to 28 hours [according so the heat of the oven], while the ordinary gas retort has to be charged and discharged every 4 to 6 hours. Most of the work can be done by mechanical means, and the saving of labor per ton of coal handled is one of the greatest and most important advantages we possess over ordinary gas retort practice. As to the production of gas. There should not be any difference in the composition except the difference of carbon remaining in the denser coke than there is in any gas retort system. The through retort has to be air tight, and if the Otto ovens are air tight there is every reason to believe that just as good gas

can be made in them. So far our furnaces have not shown the slightest trouble in leaks; in fact we feel that they are getting tighter every day. The porousness of the walls is being carbonized, and they are filling themselves so as to make very tight retorts. We have been very careful to keep the heats at an even temperature, and find that. the elasticity of the brick work is sufficient to take care of the unavoidable effect of cooling that the fresh coal has upon the walls. As regards tight retorts; they have come up to our expectation. Our coking time being a much longer time than in the ordinary gas retort gives us a chance to manipulate the gas with much more exactitude, and as a similar amount of the time is a small part of the percentage of the total; so that in separating the rich from the poor gas, a few minutes, or even an hour, make but very little change in the general illuminating power results.

To produce the 18 candle power illuminating gas we are now distributing, we run the gas from the ovens for the first 10 hours of the period of coking in the rich main, and the remainder of the time in the poor gas main. In the chart, Fig. 1 shows the result of the gas for the first 17 hours, and plainly illustrates the quality of the illuminants in the gas for the first period, which you will find is considerably higher than the average of the ordinary gas works, where the whole of the gas flows into the same main. The quantity of surplus so collected is governed entirely by the amount of poor gas required to heat the ovens. To regulate the running of the ovens properly, we found by experiment that 10 hours out of 28 is a good average, and to make it absolutely sure we run the ovens 10½ hours to 11 hours on the rich main, and when the poor gas holder drops by-pass some of the rich gas and so make up for the slight deficiency. As this device is automatic the works are entirely self-governing as to the surplus. In cold weather the cooling effect of the external air on the battery is a trifle greater than during warm weather, and in that case the by-pass is open longer, showing that more gas is used to keep up the required temperature of the ovens. In some cases we reduce the 10½ hours to 9½ (in very cold weather), so as not to by-pass any more of the rich gas than is absolutely necessary to keep up the balance. To provide against the extreme cooling effect in very cold weather, and an increasing demand of illuminating gas, we are now installing a producer plant in which we shall make producer gas from

coke breeze of about 140 heat units, and thus replace the heat value taken by the increased demand of illuminating gas above the actual surplus. Should the increased demand of the illuminating gas reach the limit, which is the whole of the gas in the coal, our candle power would become about 12 candle power, against 18 candle power, at 50 per cent. of total output. It would then be necessary to install an enriching plant. Thus, the works will be very elastic as to the production of illuminating gas, and it will be only a question of forcing or diminishing the production of the producers to make up the variable consumption of the poor gas heating the ovens as the outside temperature and illuminating gas demand require it.

We depend a great deal on our by-products for the financial returns of the plant. The tar, ammonia and surplus gas are, in the order named, our principal by-product. The plant has been designed in such a way as to produce these with the least amount of labor, and every detail has been well taken care of to bring all losses to a minimum point. The sulphate house, we feel, is the best of its kind, the result surpassing all expectation — the sulphate being always of a uniform color and standard of ammonia contents. The location in Boston for such a coke plant is especially well adapted. Hard fuel is high in price, while soft coal can be bought at a comparatively low price, and the present market has been favorable to our conditions. The coke as a fuel has taken very well, has proved itself efficient, and is liked wherever economy is desired. The tar has been disposed of for several years to come. The sulphate has been in enormous demand, and our product promises to be the standard article of the country, on account of its uniformity in composition and color. The gas, as most of the members well know, has been very satisfactory in every respect. While it is a well known fact that the coal we are using contains a great deal of sulphur, we have been able to keep the sulphur far below the Massachusetts legal requirement with six double boxes. and we are now putting in our purifying house six more, so as to give a better chance to work the lime to its full absorptive capacity.

I think when this chart is published, which I understand it is going to be, it will give you a good resumé of what the works have done on the 17th of this month. (Applause.)

Table of Present Operation of the Works, Feb. 17th, 1900.—Consists of 300 coke ovens making coke; 50 coke ovens heating now being charged. The last 50 coke ovens almost completed, will be ready to make coke the 1st of March.

The present output is scheduled on 29 hour time—an average pushing of 250 ovens per day, equal consuming 1,500 tons of slack coal, making 1,000 tons of coke in 24 hours.

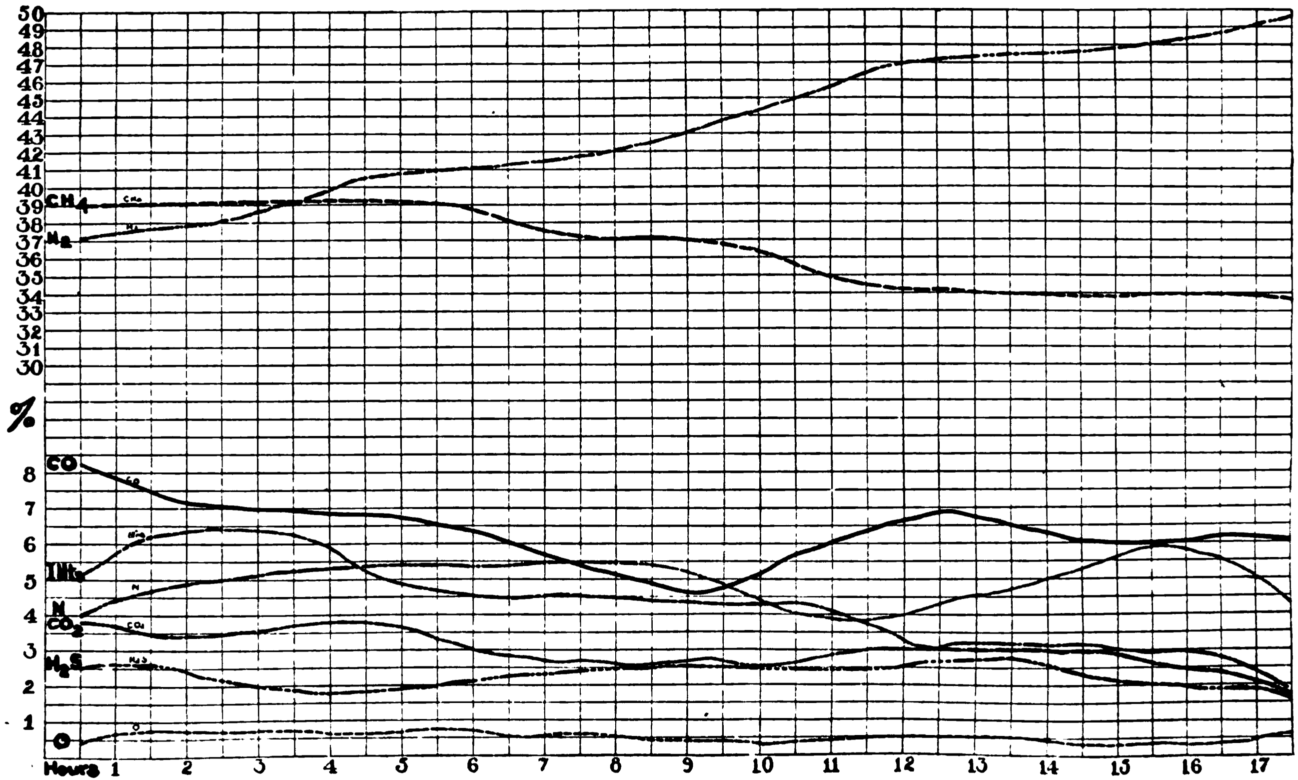
The by-products are: 67 tons of tar; 16 tons sulphate of ammonia, and 4,500,000 cubic feet of 19 candle power gas. Consumption of lime, 16 tons per day.

Analysis of Gas, Taken Feb. 14th, 1900.

Period.	H_2S	CO_2	Illuminants	O	CO	CH_4	H	N
2nd hour	2.7	3.5	6.4	.8	7.	36.9	37.9	4.8
7th hour	2.4	2.7	4.9	.6	6.	36.93	41.57	4.9
14th hour	2.7	3.1	3.0	.6	6.3	33.72	45.89	4.7

The President—I think we can congratulate ourselves over hearing for the first time the results and facts from one who knows them, instead of talking in the air as we have been doing for months, and practically for the past two years. It was intended to make this a continuous topic and have the discussion afterwards. I would like to have some expression as to whether you would like to discuss this portion, and then go on to the next, or have the four gentlemen say what they have prepared and then discuss it generally. I think it would be better to have them all go ahead, combining the discussions. If there are no objections, I will ask Mr. Fred. Mayer, of Baltimore, to address us. I want to thank him particularly. He has come from Baltimore at considerable personal inconvenience. I had to get him on the long distance telephone finally to get him here at all.

Mr. Mayer—Mr. President and Gentlemen of the Association: I came here entirely unprepared for the subject upon which I am requested to make a few remarks, and upon a special invitation of your President, to whom I am very thankful for his kind remembrance. As I am extremely busy at this time of the year, I was hardly able to leave my business, and for that reason was absolutely unable to find time for the preparation of any paper. I shall, therefore, only make a few general remarks referring to the inclined retort system. Through an



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extended trip to Europe, of over four months duration, two years ago, I investigated very thoroughly the inclined retort system, and, as a result of this investigation, I proposed to a gas company in Brooklyn, N. Y., for which I am building a new plant, the adoption of the inclined retort system. This gas company has no other source of producing gas, and is at present under contract with another large company for its supply of gas. The present contract expires on July 1st of this year. From this you will note that, upon the expiration of the contract, the gas company will have no other source of producing gas, except that received from the inclined bench system now in course of construction. That I am well satisfied of the producing capacity of the new plant with inclined retorts, and that this system will produce exactly what I told them it would, you can be assured of, as otherwise I should not have recommended the same. The inclined retort system is, in my opinion, a step in the right direction for the future production of gas in this country, providing the prices of oil will remain at the present level, or increase to a higher one. In the system of inclined retorts there is no claim made, as you probably know, for a greater production of gas per pound of coal, or that there will be obtained a greater amount of by-products than with any other bench system of good construction, but that there will be a decided reduction in the retort house labor, there will be no question. In determining the system that would be best adapted for the purpose of the company to which I referred a few minutes ago, and the plant which I am now constructing, I made a careful investigation of the various systems of coal gas production. The production of water gas was not considered, and entirely excluded on account of the present high prices of oil. The plant, however, is so arranged that a water gas system may be added at some future time. To determine which is the best coal gas system to install, it is absolutely necessary, in my opinion, to consider the cost of construction and the cost of operating in conjunction, to which must be added a fixed interest charge of the same amount in all instances. Without the addition of such fixed interest charge, the proper value of the plant and its efficiency cannot be arrived at. I have with me the calculations which were made at the time that the system of the producing plant of the works above referred to was considered. I have had no opportunity to examine them since the calculation was made,

[illegible] to look over them for a minute to refresh my [illegible] question under consideration was the produc- [illegible] 700,000 cubic feet of gas per day, and I [illegible] installation there would be required, at an [illegible] cubic feet of gas per pound of coal, either [illegible] with full-depth regenerator furnaces, 8 [illegible] similar furnaces, either charged by hand in [illegible] or supplied with charging and discharging [illegible] benches of 9's, with inclined retorts constructed [illegible] system. I found that, by applying the same [illegible] distance and the same wages for the various [illegible] house and for handling the coal, for a time [illegible] 365 days, and allowing in each [illegible] interest of 6 per cent., the following: In the [illegible] 12 benches of 6's, the total cost of construc- [illegible] the benches with full-depth regenerator [illegible] house, with the charging floors, etc., complete, [illegible] entire installation would be $53,136, or [illegible] cubic feet. I further found that with [illegible] operation for retort house labor only, [illegible] of coal and coke, would be 8.75 cents [illegible] gas. From the above you will note [illegible] of cost of construction, plus the cost of [illegible] interest charge of 6 per cent., amounted [illegible] cubic feet of gas produced. With [illegible] horizontal retorts having full-depth regen- [illegible] total cost, arrived at in a manner similar [illegible] 12 benches of 6's, amounted to 9.4 [illegible] feet. These same benches supplied with [illegible] machinery showed a result of 6.61 [illegible] feet, whilst that for the 5 benches, with [illegible] the Coze system, showed a result of [illegible] feet.

[illegible] price was with charging and discharg- [illegible]?

[illegible] charging and discharging machinery was [illegible] of 8 benches of 9 horizontal re- [illegible] result of 6.61 cents per 1,000 cubic [illegible] does not differ a great deal from [illegible] the system with inclined retorts, I [illegible] calculation of the efficiency of the

inclined retort system I have applied the lowest factors possible, for the reason that these figures were to be submitted to the Directors of the gas company, and I intended to be on the safe side with reference to the results to be produced, providing the system of inclines was adopted. In all of the above instances of various systems with horizontal retorts, I applied factors rather above the average value of the cost of construction and results as at present obtained in ordinary retort house practice in this country, and I feel sure that the results which will be obtained with the inclined benches will prove by far better than those shown in the above referred to calculation. The retort house labor alone for the inclined retort system in this case amounts to 3.48 cents per 1,000 cubic feet, but as I have stated before, this cost is based upon higher factors than those which will be applied in actual practice. The higher factors were applied for the simple reason that, in the matter of determining the best system for the interests of the gas company, I represented a manufacturing concern which was bound to make good its word upon the completion of the plant, by the production of such results as it had guaranteed. The coke consumption in benches with inclined retorts, which I am now constructing, I do not expect to amount to more than 15 per cent. of the coke produced for the average of the year. Gentlemen: I am at present placed in rather a peculiar situation. As you know, I am the representative of a manufacturing concern and do not wish you to think that I came here for advertising purposes, and for that reason I trust you will excuse me if I abstain from further remarks about the details of construction of benches with inclined retorts and its advantage over all other systems. But with regard to results which are expected from the installation, I desire to state that, as the plant has to be in operation not later than the first day of July, and will produce, beyond a doubt, at least such results as we have guaranteed, or perhaps better, and as this date is only a few months distant, I shall be better able to advise you in the near future and before the expiration of this year, of positive facts and results obtained, which I am sure will be more acceptable to you than any claims for expected results that I might make at the present date. When such results have been produced they will not be open to dis-dissussion as any claim for expected results would be at the

present day, simply because they will at that time be undeniable, positive facts. In accordance with the request of your President, I have prepared in a great hurry a sketch showing what I might term a typical presentation of a coal gas works having inclined retort system. By an examination of the sketch you will observe that, with this system of gas production, coal may be handled and converted into coke, absolutely without any human labor, providing the conditions would be such that coke sales would be in the same ratio as the coke produced, minus such portions that are used for firing the benches. I understand, of course, that such condition cannot always be expected to exist, and in all probability will be rarely obtained. However, it shows what can be done under the new system. By referring to the sketch you will note that the only handling of coal (and I may say that in this sketch the principal details of plant I am now constructing are incorporated), will take place at the time the coal is received at the dock or wharf of the gas company. The coal will be handled from a barge by hoisting to the upper portion of a tower specially constructed for the purpose, to be weighed upon a scale, then to be transmitted into the crusher and from there to a hopper underneath the crusher into coal cars, to be conveyed directly to the coal storage shed, which later will be constructed with inverted cone shaped bottoms, all suspended above the ground with sufficient clearance to permit of walking underneath them. From the coal shed the coal will be taken by cross conveyors into a central longitudinal conveyor, and from there to the end of shed to be deposited upon the retort house conveyor, for the purpose of elevating the coal directly into the overhead storage bins constructed above the benches. The coal will be supplied from the overhead storage bins in retort house by means of automatic charging chutes to the inclined retorts, and the coke will be drawn from the lower end of the retorts into a trough, filled and constantly supplied with water in front of the benches, to be transferred by a conveyor of special design to the end of retort house and outside of same.

The coke after leaving the retort house is at once passed through a crusher of proper design to reduce the size of same to become available for domestic purposes. From the crusher the coke is passed by the conveyor to a screen having variors sized openings, to be deposited in overhead bins, according to

the size. If the coke sales should not be in the same proportion as its production, it will be necessary to by-pass the coke pockets, which can be readily done by a simple arrangement, and the coke will then be deposited in the coke yard, to be taken from there some future time to the overhead pockets, before referred to, to be conveyed from there by a gravity discharge to the coke carts below. (Applause).

The President — If Mr. Mayer realized the intentness with which he was listened to by everyone, as I particularly observed, he is well repaid for coming to talk to us. Will Mr. Ramsdell, of Philadelphia, now come forward?

Mr. Ramsdell — I feel a little embarrassed in the present situation, for it would look as though I am placed in the position of defending the horizontal retort, and I don't want to be so understood. I believe that all three have their proper sphere.

The President — Excuse me, Mr. Ramsdell. I want it understood that the idea was to present all sides of this question, not necessarily that we are defending one kind or another.

Mr. Ramsdell — I did not mean anything personal at all. No subject was assigned to me, as far as that is concerned. I was simply asked to be prepared to take part in the discussion on this important subject. I have studied a good deal on this subject of inclined and horizontal retorts, and I must confess that I am not yet quite clear as to which I would advise. As I said before, I think there is a place for each of them, and I think the location has a good deal to do with that point. As far as our Company is concerned, we are in the market for both. I don't propose to talk from the construction end of this at all; I am simply talking now as a gas man. This question came up in our own business in the rebuilding of one of our plants. While there were some reasons that prevented us from giving it as full discussion as we would have liked, yet we decided against inclined benches, although we were building a new works. That was very largely on the ground that we would have to do a good deal of experimenting, or at least were afraid we would, and also from the fact that we were very short of time in which to complete the plant. The first installations of these inclines will of course take longer than later ones, for various reasons which are very easily understood by

any gas engineer. We have a man at the present time in Europe making a thorough investigation of this whole subject, and I hoped he would be back prior to this so that I could have gathered information from him to talk a little more intelligently, but I am giving you the benefit of what I know up-to-date. We found that, as near as we could make out, the results obtained were practically the same; that is to say, with a modern retort house, built in the most approved, up-to-date fashion, with machinery, the residual results and cost for labor was practically the same. The cost for hand labor with horizontal retorts is from 8 to 10 cents per 1,000, with drawing machines alone, from 6 to 7 cents, with drawing and charging machines from $3\frac{1}{2}$ to 4 cents, and the cost of labor with the inclines is about the same. Our investigations show that they have never reduced this more than a third of a cent below the $3\frac{1}{2}$ to 4 cents. As far as the cost of construction is concerned, I think all of these costs should be compared on the cost per 1,000 of capacity, and not per retort or per mouthpiece. It is very misleading to figure up the cost of a gas works at so much per mouthpiece, whereas if you take the capacity per 1,000 feet produced the comparison is fair. I have no figures that I would like to quote here off-hand on the cost of the different plants. One factor in the matter of inclines may be important in our larger cities or in any community where the conditions are such that the space available is limited. You can undoubtedly make more gas per square foot of area with inclines than you can with horizontals. The horizontal bench of today, the modern up-to-date bench, is of very large producing capacity, but at the same time with the inclines, as you can very readily see, you can get a longer retort in the same space, and therefore get a greater capacity. But outside of that it seems to me the honors are comparatively easy at the present time. We don't know as much about the inclined bench as we will a year or two later.

The President—I did not know, when Mr. Ramsdell wrote to me to say he was particularly interested in the matter of this kind, that we were going to be so fortunate as to cover the ground as well as we have. I hope that if we can't attend the American meeting in a body the New England Association will be largely represented at Mr. Ramsdell's meeting next October. Now if any other gentleman will please volunteer. Perhaps a

limited number of questions may be answered, but I should not be disappointed if the gentlemen would say, as we used to say at school, "Not prepared." I congratulate the gentlemen that they covered the thing so thoroughly.

Mr. Wood—I would like to ask Mr. Hirt if they have ever taken any temperature test of the charge in the retort; if he knows practically or approximately what temperature they maintain in the retort.

Mr. Hirt—No; we have not taken any pyrometric temperatures at the ovens in our plant, but it has been done in others. We desire not to exceed 1900° F. in the ovens to make the gas we are making today.

Mr. Nettleton—I would like to ask both Mr. Hirt and Mr. Mayer if they have gotton far enough in their investigations to say with any degree of certainty how small a gas works can put in either a coke oven plant or inclined retorts. I think most of us in the room represent works with a sendout of less than one hundred million, and whether a works of that size can use either of these systems has been a question in my mind.

The President—Mr. Hirt, will you answer first, if you are prepared to?

Mr. Hirt—A plant of about 20 ovens is the smallest I would advise any one to put down. We have in Halifax a plant of 10 ovens that runs very satisfactorily; but I think 20 would be better.

Mr. Nettleton—May I ask what is the production of gas available for sale from 20 ovens?

Mr. Hirt—It depends a great deal on the coal that you have to make gas from, what weights of oven and what kind of coke you have to make. If it is a very hard foundry coke it takes a little longer to run; it may make two or three hours' difference in the plant. If it is a coal that has very low volatile matter, it makes more coke than it makes gas. All those things have to be taken into consideration. But take it with the coal at Halifax. They are making about 70,000 to 80,000 a day, I believe; sometimes more. Mr. Addicks can tell you more about it than I can. All I can say in regard to 10 ovens, as far as the labor is concerned, which is really the point I wanted to make, is that it is just as cheap for you to

run 20 ovens with labor per day as it is to run 10, for a series of men in 10 hours can push 20 ovens for the same money. It takes about so many men to do the work, whether there are 10 or 20 ovens. If there is any way at all to sell the coke I think there would be more profit in a 20 oven plant than there would be in a 10 oven.

The President — I think, in reply to Mr. Hirt, it was somewhere between 150,000 and 200,000 a day, but I don't remember distinctly. I would not like to have that stated as a fact. Mr. Mayer, do you care to say anything? Please feel perfectly at liberty not to say anything. I expressly stated that to you.

Mr. Mayer — To the question of Mr. Nettleton I desire to state that I have no personal opinion at present, and cannot until we have produced results from our own coal and under our own conditions. I don't know but that our coals may vary in the results as compared with the German or English coals, but I do know that in one place in Germany where the installation of benches with inclined retorts was under consideration, it was decided to erect one bench of 9's instead of several benches of 6's, and from this decision I judge (I have not the exact figures in my mind at present) that the production per day of this works was not over 150,000 cubic feet. I have been informed that the installation has given great satisfaction regarding economy in retort house labor as compared with the old installation of horizontal benches with 6 retorts.

Mr. Ramsdell — Mr. President, could I now say one thing that I forgot to mention when first speaking. I don't want to be considered as talking shop here at all, but I do feel like calling attention to the point that has been made here recently of the results in the coke oven processes. It seems to me that the strongest point brought out by the coke oven people is the very high candle power which they have obtained by a simple manipulation of the gases; in other words, of taking their gas at certain periods of the carbonization. This seems to me possibly the weakest spot in our present system of coal gas making. A gas engineer about five years ago told me that in his judgment there was not less than 25-candle power in such coals as the standard gas coals, and I, as most any of

us would, smiled and thought that that was a very extravagant statement. At the same time I believe now he was nearer true and correct than I was in my opinion at that time. His theory was that we robbed the gas of part of its illuminants as it passed from the retorts to the holder. The coke oven people have shown us that where they expected to get 12 candles, by simply manipulating that gas, they have taken out and put into their holder for distribution gas from 19 to 21 candle power. This shows we are possibly doing our gas making on a wrong theory; in other words, are we not making a rich gas and, because we do not handle it properly, robbing it of its illuminants and putting it into the holder so that it goes out to our consumers at a less candle power than we could get for the same expense if we simply handled it properly? I have heard gas engineers of good standing say it was impossible to extract more than 16-candle power out of standard gas coal. We know that is not correct, for we have done better than that, even with our present appliances. I believe the most important feature brought out by the coke oven people for the gas fraternity is to call our attention to this very point. They have shown us that in our present manipulation of the gas from the retort to the holder we are robbing it of part at least of its illuminants, and we are under obligations to them for this development.

The President — Of course Mr. Ramsdell has to keep in mind that there is a smaller number of feet put into the holder at this higher candle power.

Mr. Ramsdell — I understand that; but that does not effect the principle.

Mr. Fowler — Mr. President, some years ago (it was really before I came into the gas business), in a small works where I was interested I had occasion to experiment on the use of an exhauster. It was an exhauster run by a stream of water, very much like the steam exhauster, except that we used a stream of water instead of a stream of steam. For that purpose we ran a single bench for a certain number of hours at one time with the water exhauster and at another time with the water exhauster out of use. I found that the candle power of the gas as we made it was quite high during the first two hours, and during the last two hours of the charge it was

quite low. As I understand it, it is that fact which the retort oven people are now utilizing; in other words, that the gas is rich which is first made from the coal, but poor after the coal has been in the retort for a considerable length of time. I don't understand that they have proved that they have any ability to manufacture a large quantity of high candle power gas, but that they have proved that a certain quantity of the gas which they manufacture is of high candle power, and that portion they use for distribution as illuminating gas.

Mr. Coggeshall — I think on this point it would be practical to know the quantity per lb. of coal produced when it is taken off, up to and including the tenth hour.

Mr. Hirt — We have not been measuring in that way. Our plant is of such large capacity that everything runs by the ton. As far as the flow of gas is concerned we don't seem to find any difference from the first to the last hour, except we think — we have not been able to measure it — that as the gas gets drier towards the end, the flow is a little sharper than it is at the beginning; but we have not been able to make any measurements. We have 50 ovens run into one main and all connected together. We are in hopes to connect up three ovens very shortly and make a test of such kind, but we have not been able to do it yet. Our main point now is to get the plant finished and running.

Mr. W. A. Learned — Did I understand Mr. Hirt to say he was getting betweet 2,000 and 3,000 feet per ton of 18 candle gas?

Mr. Hirt — As I illustrated in my introduction to this discussion we run 10 hours out of 28. That means a little more than one third of the gas that we are getting an hour in each main, and say 60 per cent. of poor gas. Figuring it out in heat units, we get 45 per cent. Figuring it out in candle feet, we get 45 per cent. of the gas in the coal. That is, at the 18 to 19 candle power, we get about 34 to 36 now. This is the reason why I mentioned in my paper that should the illuminating gas demand increase we can still replace the heat units that we are robbing from the heat of the ovens by a cheaper producer gas, that cannot be transported in the streets but can be transported in the works, and so used to heat the ovens and still be quite a benefit and bring this charge down to this

point. That is the very reason I explained that at the seventeenth hour, to show you whereabout the limit of illuminating gas is.

The President — I think we will have to close the discussion. It is getting after 4 o'clock and we have another paper yet to read. I presume I may thank these gentlemen for the Association (Messrs. Hirt, Mayer and Ramsdell in particular), and all the other gentlemen in general who have entered into the discussion, for the interesting information they have given the rest of us in this discussion. I would like to have the endorsement of the Association for the three gentlemen named. All in favor please say aye. A unanimous aye was the response.)

Mr. N. O. Goulding, of Natick, Mass., then read the following paper on

FOUR YEARS' EXPERIENCE WITH PREPAYMENT METERS.

In the spring of 1896 I was appointed Superintendent of a small gas works. The second day of my advent in town I was ordered by the manager to cut off the gas supply to a certain person, on account of non-payment of previous gas bill. Being a stranger in town and not liking to make an enemy of one whom I found on investigation to be a user of gas to quite an extent, I suggested a prepayment meter, and two were ordered from well known makers. The same were set for the reason named above, and gave great satisfaction to the consumer and the Company. Since then I have set quite a number under the same conditions, and it has enabled us to keep business on our books that we could not have done with the old meter.

We now have about 40 prepayments set. As to their service, I find that about half of them have given me more or less trouble. Some would refuse to respond to the 16 to 1. Others have refused to pass the money. A few have been found wanting when the cash box was opened and the money was not there to any extent. In looking over my note book I find I have had trouble with 15 prepayment meters since April, 1896. This leaves me with about 25 to speak in praise of, and I should not want to sell them to any extent. But, oh!

those 15. They have caused me to think many times that a prepayment was a snare and a delusion. Our book keeper is a lady, but when the cash does not balance who would blame her if she spoke her mind freely.

I would say right here that we have had four makes of prepayments, and have had the same trouble with all makes, and I also find that we have the four makes in places at present that have so far given the greatest satisfaction, so that the manufacturers of meters who may be here at this meeting cannot take the credit of the good ones and leave those 15 on some small fellow.

Now, to close, I would say that, with all its faults, I love it still. And if these faults are remedied, I should place the prepayment meter with the Welsbach burner, as the two factors that will make our business flourish like a green bay tree.

Having concluded the paper proper, Mr. Goulding further remarked: In our President's address this morning, if I remember correctly, he stated that in his judgment it was not the mechanical part of the prepayment meter that would make it a success. I am not sure that I am quoting him correctly, but the substance of what I was getting at was that the mechanical part of it was not what he was looking after. If my paper and my four years' experience mean anything, they mean that what the small gas companies at least are looking after is a prepayment meter that, when we put it out today, tomorrow we know it is going to work just as well as the ordinary meter that we have been buying for the last 25 years. The prepayment meters that I set the last four years (those that were correct and have been correct all these months) were correct the day I put them up. I have never taken out a meter that was in three weeks or two days. The meters that I have found fault with, that I have had to remove and send back to the manufacturers and have them adjusted, have been the meters that refused to work the very moment we put them in. We have meters today that have given perfect satisfaction to the consumer and to the company from the day they started, showing that it is a mechanical possibility to make a prepayment meter that is mechanically correct. The point that I make is that it is in the manufacture of the meter itself.

Discussion.

The President — Mr. Goulding, if you will stay here you may have something more to say. I supposed that some one else would take a different view of what I said this morning in my address, and if that is the case I am perfectly satisfied. As President I assume that I must be entirely unprejudiced and unbiased. Now, gentlemen, this is a question on which I have no doubt everyone wants to get up at one time and talk about. If we can't do anything else we will call some of these meter people and ask them why it is.

Mr. McDonald —Mr. President, certainly I cannot help but laugh. I have not the slightest desire to talk shop at all here, and of course because of that I am exceedingly careful what I say. But I will relate a little bit of history. In the early days of the prepayment meter I sold to a gas company in Boston 50 prepayment meters. If that company will return them to me I will give it in return a bonus for them. This illustrates the idea that I think the gentleman has advanced in his paper. There are prepayment meters and then again there are prepayment meters. I think the people who have made prepayment meters have made mistakes. They were infants. They had to grow up. They had to have their experience. They sent out meters that were not what they ought to be. But I think I can without question tell the gentleman that today there are prepayment meters that mechanically are right. I don't think I need hesitate at all when I say to him one company in this country has over 50,000 prepayment meters in use, which is a large number, and there is no fault found with the mechanical construction of the meter. The company had the same troubles that the gentleman who wrote the paper had, meters were in use that did not work. And they were made by all the manufacturers. It is not because one manufacturer more than another made meters that were better than another, but meters from all manufacturers gave trouble. But the days of trouble with prepayment meters have gone by. I can frankly say prepayment meters are made today, not only by my own concern but by other concerns, that are just as durable, just as sure to be accurate and to give just as little trouble mechanically as the ordinary meter. I think that I can say from what I know of the prepayment

meters that are being made in this country today that the prepayment part of the meter is really just as reliable and more durable than the meter itself.

The President — I believe thoroughly in prepayment meters. We have had more or less experience with them and, as I have said before, I doubt very much if there is as much trouble mechanically with the prepayment meter today as there was in the original gas meter when that was originally made and put on the market. There probably would not be one tenth the amount of trouble.

Mr. McDonald — Mr. President, might I go on a little farther?

The President — Yes.

Mr. McDonald — I have had a good deal of experience with prepayment meters, and have, of course, sold them to quite a number of companies. I can say to the gentlemen here this afternoon that all of the companies who have used the prepayment meter long enough, and enough of them to get an experience with their use, have become satisfied that they are a good thing. There is no question in my mind but that consumers can be obtained with the prepayment meter that cannot be obtained in any other way. I believe this will prove to be the experience of any gas company that takes the prepayment meter up and attempts it use. I feel sure that all will be well satisfied with its use as it is today, not as it was 4 or 5 years ago, when it was an experiment and when no one knew very much about it. But I know that the mechanical construction of the meter is such now that there need be no fear in attempting its use.

Mr. Goulding — Mr. President, my paper was written in response to our worthy Secretary's request for contributions some two or three months ago, probably. I am a firm believer in the business proposition of a prepayment meter to a small outlying district, especially where we have a small and rather poor class of people that otherwise we would not want perhaps to trust for two or three months' bills, or one month's bill. The last speaker said that the meter that we are buying today is not the meter that was made four or five years ago. I want to say that my company has got the very first meter that it bought. It will be four years the coming April that we

bought it, and I found by looking over our consumers' books yesterday morning that that meter was in operation today, was giving perfect satisfaction to the consumer, perfect satisfaction to the company and myself, and was correct. We have meters that we bought last fall. Not over three weeks ago I had to send three back to be changed over and fixed, meters that were called modern meters. I remember about last March or April an agent for a meter manufacturer called on us with a model that he claimed was a perfect prepayment meter, and we ordered six; three of them had to go back. But four years ago we ordered meters from four different manufacturers of that day. I have four of them and they are all in working order today. The point I want to make is that the few meters we bought four years ago (four samples, you might call them), the first ones we ordered, are working today, have always been found correct and have never given any trouble to consumers. Of course, we are a small company, and have only a few out in comparison with other companies, but we have never had to take a prepayment meter out of anybody's house or store, unless through death or removal or that the meter was not correct. The prepayment meter is what we want, as I stated in my paper, if we can get one that we can rely on.

The President — Mr. McGregor, we would like to hear from you in regard to prepayment meters.

Mr. McGregor — In connection with prepayment meters I am sorry I am not the last one to have something to say on this question. I have had a great deal of success with prepayment meters, and consider all the prepayment meter manufacturers my best friends. I think I have five different manufactures of prepayment meters. I have 1,336 meters in use today. My collections in two years amounted to $30,216.15; cubic feet represented, 20,144,100. The loss that I have figured from defective valves (valves not closing off after the quarter's amount of gas was consumed), and from breakages, of which I had quite a number, and other causes only amounted to .49 per cent. I noticed in a paper printed in the American Gas Light Journal, a statement showing a 2 per cent loss. I started to introduce those meters about 4 or 5 years ago, and the first meters that came out are not as good as the meters that we are getting today. The meters that we have had within a year I have absolutely no trouble with at

all. The prepayment meter has been a great source of income to us. I have noticed with quite a little degree of amusement that if the gas could be sold for 15 cents more per 1,000 than the ordinary rate, it might be proper and becoming for gas manufacturers to sell gas through prepayment meters. Even if we lost 15 cents per 1,000, or if on the gas we sold we did not realize by 15 cents what the usual selling price was—the price that I sell at is $1.50—even then I consider it a first-class customer. A question was asked me some time ago by a gentleman who wanted to know the difference between the amount consumed by a regular meter and that consumed by a prepayment meter. I went over my list of 1,336 meters last month and I found I had substituted 34 prepayment meters for regular meters. The average consumption by regular meters was 1,663 cubic feet per month, that by prepayment was 1,181 cubic feet, of those 34, which showed a decrease of consumption of 29 per cent. in the prepayment meter over the regular meter. I would advocate by all means every gas man putting in prepayment meters, in order to accommodate a certain class of customers. I know certainly that the expense of collection and the trouble in keeping the meters in order are very much less than the 2 per cent. that the majority of authorities that I have read have given.

The Secretary — I would like to ask Mr. McGregor if he means to say it is his opinion that in ordinary practice the installation of a prepayment meter will reduce the consumption of a particular customer?

Mr. McGregor — Well, out of 1,336, I can only say that 34 of those meters that I substituted for regular meters show a decrease in consumption of 29 per cent. I think that a person is more careful. I stated two years ago I thought they would be a little more careless in consuming gas where the bill was not presented, but I really think they are more careful in consuming gas where they have a prepayment meter than where they have a regular meter. I would say that, out of these 34 customers, if I had not put in a prepayment meter, I would have lost the customer altogether.

The President — Mr. McGregor, I think that makes quite a different statement.

Mr. Nettleton — I should like to make a small addition to the discussion. I have been using pre-payment meters since

the fall of 1896, commencing six months later than Mr. Goulding, and uniformly these meters have given satisfaction. We now have something over 800 in use. Our income from these meters will exceed $12,000 this year. I am quite confident that a large part of these consumers would not be using gas at all but for the fact of having a pre-payment meter. The majority of them, more than half, are people earning small wages. Most of them are living from hand to mouth. The bills at the end of the month with the ordinary meter would naturally run from $1.50 to $2.00, and they would find great difficulty in paying that amount. They do not find difficulty in putting 25 cents in the meter once or twice a week. With a few of the cases the bills are very much larger than with the ordinary meter. I have in mind the lunch wagons. I think we have 6 or 7 that we supply through prepayment meters. Those are run. I think, in almost all New England towns by people who do not have a great deal of money. These wagons are paying from $125 to $150 apiece a year, where formerly they had bills of $6 or $7 a month. There was difficulty in collecting, and I think in one or two cases gas was given up. Now the bills are larger and more easily paid. With that class of people the prepayment meter is admirably adapted both for them and the company. It gives them what they want, it makes the paying of their bills easy, and, for the company, you are sure of your money unless the meter is robbed, and that in the small places is very rare. I think perhaps we have had three meters broken into in the 3½ years that we have been using them. Now, as to the trouble. We practically have none at all. The meters give us no more trouble than the ordinary ones. I remember, two or three years ago, somebody used occasionally to complain that the meter would not act, and we found they had not put in the quarter in just the right way, but that trouble has practically disappeared. We have found one case where the meter passed some gas without shutting off, but they are very rare. As I am giving the experience of three or four years and out of what is now over 800 meters, I believe I am warranted in saying we practically have no trouble at all. At the present time, out of 2,400 meters all told, we have one-third pre-payment meters, and the tendency is to change very rapidly. Whether, as we change, we are going to accumulate a lot of ordinary meters, I don't know; I hope not, but a good many people are changing.

They find them a great convenience. Certainly I can agree with Mr. McGregor, that the collecting, making the necessary records and the labor of taking care of them, are no greater, I believe not as great, as with the ordinary meter.

The President — Mr. Woodward, we would like to hear from you on this subject.

Mr. Woodward — The Secretary wrote to me in reference to the matter of prepayment meters, knowing I was particularly interested. Two years ago I made some remarks about prepayment meters here and I have always been an advocate of them. I did not suppose the question of the accuracy of the meter, as to its mechanical construction, would be brought up, because from our experience it does not seem to be open to discussion. As far as our experience goes, we have had no trouble with them at all. We might, out of 300 meters, in the last four years, have had 8 or 10 broken open, but have had in no case any trouble with the recording apparatus or with its working satisfactorily. The suggestion that the Secretary gave me was this: To show, if possible, whether or not the prepayment meter increased consumption per meter. I worked over our books carefully and determined very readily that it had increased the consumption. But you must bear in mind that in the last four years we have reduced the price of gas three different times, and so I cannot give an entirely fair comparison. Four years ago we estimated that a prepayment meter ought to bring us an annual consumption of 10,000 feet; today our prepayment meters are bringing us an average yearly consumption of 13,100 feet, and regular meters that supply the same class of consumers are bringing us a consumption of 16,800 feet. We don't really push the prepayment meter at all. We never have pushed it, chiefly because the prepayment meter costs a good deal more than the other meter to put in. Our business is partly among a class of customers who are largely transient, and we have to ask deposits from tenants, and so, if a person objects to paying a deposit, we sometimes put a prepayment meter in to obtain a consumer. We are certainly reaching a class of people with the prepayment meter that we would get in no other way. That has been spoken of today, and I cannot say more than to emphasize it. We, in our place outside of New York, have a great deal of construction work going on by the city and contractors, and

there is a settlement that is full of the worst class that come to this country. They work for small pay and are very prudent. We have induced those people to put in gas with prepayment meter. They don't care so much for the light, but they are using gas stoves with the prepayment meter. They bring us a nice return, and we have no trouble with their meters. We could not trust these people for a month's gas bill, neither would they pay a deposit. After the thing is once started and they see their neighbors using the prepayments they become interested. I never could see where there was any additional cost, outside of the meter itself, in the installation of the prepayment meter. It costs no more for our office force to handle prepayment meters, and I hardly believe it costs as much. The same men that read the indices of other meters read the indices and bring in the money for the prepayment meters. The tally slips are handed in to the cashier, with the money, and entered on the gas consumer's ledger, and that is all there is to it. It is a simpler way of collecting than sending out a bill; it saves postage and the consumer does not have to come to the office to pay the money. We think it simplifies the business of our company. Another thing not to be spoken of lightly is, there is absolutely no complaint from the consumer when he has a prepayment meter. The matter is entirely in his own hands. He cannot say, "My bill is to big; I cannot understand it and want my meter tested." We do not hear from him in complaint. If he has a prepayment meter he keeps right on using gas and very seldom stops, because the matter is in his own hands and directly under his control. Just one more thought. While our average shows 13,100 cubic feet per year on prepayment meters, yet we have been able to hold some large consumers where the payment of a monthly bill was almost impossible. Large saloons and like places, that were always bad pay, we now have on prepayments. I have in mind one consumer that we sold last year through a prepayment meter 120,400 feet, or, at our rate of $1.25, he paid us $150.50. This case alone ought to show what these meters can accomplish in the direction of helping swell one's collections.

The Secretary — It seems to me one phase of this prepayment meter question has never been touched upon. I suppose all of us believe that the average person shows less intelli-

gence in his consumption of gas than in his use of any other domestic commodity. It seems to me that the prepayment meter as an educator in the use of gas would be of great value to increasing mutually pleasant relations between the gas supplier and the consumer, and it is no doubt probable that in the majority of cases intelligent use of the gas would result in a decreased gas bill. In my mind the explanation of the two cases stated, where the bills were smaller with the prepayment than with the ordinary meter, is that the consumer gives more attention to his gas and does not waste it, whereas he otherwise did. As an educator of the consumer of gas it seems to me a good thing to have, though in individual cases it may result in a reduced consumption.

The President — I would like to add to what the Secretary said that with the straight meter the consumer did not want to pay his bill after he had burned the gas.

Mr. Gould — My name has been brought up in connection with the McDonald meters. I would say in justice to Mr. McDonald, that the reason those meters were side-tracked some three or four years ago was that they were set in the basement of apartment houses and the cash boxes got very much demoralized by being broken open by thieves. I don't know that it is anything against the meters. We now set prepayment meters only in rooms under sole control of the consumer.

The President — The discussion seemingly being closed, I will again go contrary to the regular order, and read this question from the Question Box:

"Method of Handling Money and Accounts of Prepayment Meters."

This is suggested by a gentleman from Connecticut. Who will give us some information on that?

Mr. Woodward — The question does not seem quite clear. Does it mean how the matter is handled? It seems to me it is such a simple thing it cannot admit of very much discussion. We have our regular men who read the indices of all the meters and collect the money. They have their routes and each has a key. They fill out a sheet giving the folio number, the name of the customer, the index reading of the meter and

the amount of money. These are handed in to the cashier, and the record of the meter index with the amount of money is entered directly from these cards on to the consumers' ledger. I have seen discussed in another convention something about the gas company selling checks to put in the meter in place of quarters. With us our impecunious customers sometimes substitute "beer checks," good for one schooner of beer, for the silver quarter. These must be made good to us or we discontinue supplying such a customer with gas.

Mr. McGregor — We have a card representing the 12 months of the year. The name of the street and the number of the meter are printed on top. We have one regular man at present who takes the indices and also makes the money collections. He puts in the state, subtracts the amount, and fills in the cash amount that he receives with each meter. Sometimes it is over. It does not always agree, of course, because sometimes a man may put in a quarter and that represents future burning. He returns those to the office; our regular meter men are supposed to take about 250 indices a day, that is, in the regular monthly collections. He averages 165, and his district is very much more scattered than that of the man who of course takes the 250 regular statements. The card is handed in to the receiver or book-keeper, whoever he may be, who carries out the amount of the cash and compares it with the cards at his convenience. Then it is carried directly from the card to the consumer's ledger. That finishes the whole thing. It is a very simple and a very convenient way of getting at it. The cards are divided into streets and into districts, so that it is very easy for the man to go direct when we give him a bunch of districts to colleet.

The President — Perhaps some other member has a different method. So far as the Boston Gas Light Company is concerned, if I remember correctly, one collector has charge of all prepayment meters, who makes all the collections. He goes to the box, takes out the money, takes the state of the meter, enters it in the statement book he carries, turns in the statement to the bookkeeper and the money to the cashier. If the statement of the meter and the amount of money indicate that the Company is falling behind, or that the consumer is falling behind, we remove the meter and put another one in its place, so that a few hundred feet one way or the other will tell

very quickly. The principle is the same as Mr. McGregor described.

On motion of Mr. McGregor, seconded by Mr. Woodward, a vote of thanks was passed to Mr. Goulding. The President in announcing the vote said: Mr. Goulding, we thank you for your paper, and you can see from the amount of discussion that it was certainly of a great deal of interest to the Association.

On motion the Association adjourned, to reassemble the following morning at 10 o'clock.

SECOND DAY, FEB. 22—MORNING SESSION.

The second day's proceedings were commenced pursuant to adjournment.

The President called for routine business, and the Secretary read the following

REPORT FROM COMMITTEE ON PRESIDENT'S ADDRESS.

BOSTON, Feb. 21, 1900.

TO THE MEMBRES OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS: Gentlemen—Your committee to whom was referred the address of the President would respectfully report that we have read with increased interest the very able address of the President, and commend it to the careful perusal of all the members. The technical details with which the address abounds demand the closest study, as they are of the greatest interest to all gas managers. We would recommend that the proposal of your President to appoint a Standing Committee on Electrolysis be adopted, and that a committee of three be appointed by the President.

We would also recommend that a committee of three be appointed, with power to increase their numbers, to represent your Association at the International Gas Congress, to be held in Paris during the Exposition, such selection to be made from among those of our members expecting to be in Paris at that time.

In closing we would particularly note the remarks of the President on the advance in the price of supplies entering into the manufacture of gas. We agree with the President that the

increase in prices must largely reduce the margin between the cost of making gas and selling price; but we cannot help expressing the hope that the increase in manufacturing costs may not be so great as to necessitate an advance in the selling price of gas, though we fully appreciate that the result will be to delay the reductions in price which gas companies are always glad to make to their customers.

CHAS. D. LAMSON,
S. J. FOWLER, } Committee.
C. J. R. HUMPHREYS,

On motion of Mr. Neal, seconded by Mr. Leach, the report of the committee was accepted and its recommendations adopted.

APPOINTMENT OF COMMITTEE ON ELECTROLYSIS.

The President appointed as the standing Committee on Electrolysis Messrs. C. F. Prichard, C. H. Nettleton and H. A. Allyn. He further remarked that he would reserve the appointment of a committee to represent the Association at the Paris Exposition, and particularly requested that the members suggest to him the names of those likely to attend the Exposition. As the original committee of three would have power to increase their numbers, he hoped in that way the Association would have a large representation in Paris next September.

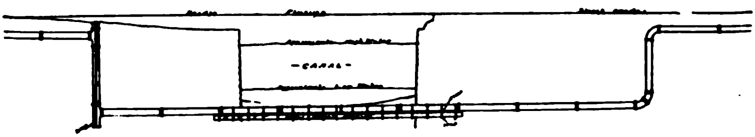
The President announced that they would consider the topic,

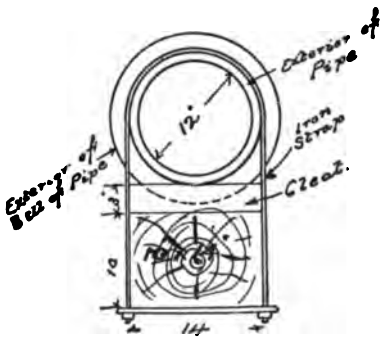
"Under-Water Gas Main Construction."

and called upon Mr. John A. Coffin, of Gloucester, Mass., to commence the discussion.

Mr. Coffin—At the request of our President I have brought a sketch of some work done in this line at Gloucester, and I will be brief in my remarks. It became necessary last summer for us to go under the canal (the Annisquam river), which connects Ipswich Bay with Massachusetts Bay, and the plan will show, much better than I could explain to you, our method of constructing that siphon. It was all tide water work, and we could only work about two hours a day upon it, which was a little tedious, but it has been in use now since the first of August, and we have practically pumped nothing from the drip. We opened that drip for the seventh time the 1st day of February and it actually blew gas. One or two little wrinkles in connection with it I think are worthy of mention. In dig-

ging at low tide we had to deal with 18 inches to 2 feet of water, and had to go 2 feet below that to take the timber which supports the pipe from abutment wall to abutment wall. In doing that digging the shovel or scoop was of no use, as the bottom of that trench was some 4 feet from the top of the water at low tide. We tried a pair of horses on a plow with extended handles for ripping up the ditch, and then a hand scoop for dragging it from bank to bank. We found that the horses did not work very nicely, so we hired the city's steam roller. It made a very good team. We dredged that out. In the center we had a boulder, about a ton, that we drilled and





blasted and dredged out the pieces. While I should not recommend to anybody with a similar job to undertake it themselves, but rather to employ somebody in that line of business, we accomplished it ourselves. All the help that we had was from some joint makers kindly furnished by the Boston Gas Light Company. The job is a complete success. In use since the first of August, it is bottle tight. To anybody that has anything similar to perform I do not know that I could suggest any improvement upon the method.

Mr. Coggeshall—I should like to ask whether the pipe is of wrought or cast iron?

Mr. Coffin—Twelve inch cast iron pipe, about 1,100 pounds

to the length, about 90 pounds to the foot, with about 4 inch bells made with lead joints.

Mr. Coggeshall—The reason you ran timber under there was on account of the mud underneath?

Mr. Coffin—No. Quite a number of stone laden vessels go through that bridge—it is a drawbrige—in the year, and they have been known to ground there on a falling tide. We put that timber there to support that pipe. It is a 10 x 14 hard pine timber, cleated every 3 feet, of the same depth as the bell, so that the pipe bears in four places, and an inch strap goes right round the pipe and timber. When we put that piece in we put the four lengths in together. We made them together on that timber, arranged a derrick on each bank, slung the pipe in the center of each section, with two bridles and four fastenings on it, and worked the derricks loose to get them to work together. As the tide fell the day that we put that in the ditch we followed the tide down. When it got about half tide we swung it off and lowered it away; at low tide put it in there. There is a very rapid current through that place (you can hardly stand on your feet) so that where we took down the abutment walls at each side we dumped rip rap stone across the channel, off 10 feet each side, to kind of break that tide. A diver was no use. We tried one twice. The tido would sweep him right out of the canal. You could not keep him in there.

The Secretary—Mr. President, I would like to ask Mr. Coffin what kind of joints were used?

Mr. Coffin—Lead joints, 4 inches in depth.

The Secretary—Stiff joints? Not an underwater joint? Ordinary lead joint?

Mr. Coffin—No; they are stiff joints. Yes, those are; only a little deeper than common. Where they are usually 3 inches these are 4. It was an extra heavy 12 inch water pipe, 90 pounds to the foot.

Mr. Allyn—I should like to inquire of Mr. Coffin whether this represents solid ground.

Mr. Coffin—*That* (indicating) is the surface and there is the wall. That wall is backed up with dump stone, and we had to go back that far to get that pipe underground and on natural bearings.

Mr. Allyn — I thought there must have been some digging there.

Mr. Coffin — It was all dumped in back of those retaining walls with boulders. Rocks are more plentiful in Gloucester than gravel.

The President — Gentlemen, I think Mr. Coffin's remarks and his very clear drawing of the siphon will perhaps be more interesting to some of the members of the Association than even the more extensive constructions you will hear of later. Any further questions to ask Mr. Coffin?

Mr. Neal — I have no questions to ask, but I merely state that I have had some experience in the use of these siphons. One was under the draw of Chelsea bridge. That was a wrought iron pipe laid by a diver. Once it was hooked up by an anchor. It is discontinued, because the bridge is now lighted by electricity. We have another small four inch siphon which we laid connecting our mains with the machine shop on the island over the Cambridge line. It has been in existence for a good many years with good results. The principal siphon (I think, 4 inches) is made of wrought iron, crossing near the draw leading to Malden. The pipe furnishes gas to a large consumer in Everett, and also to the almshouse in Charlestown. Considerable gas is used there. The way we laid it there, we disregarded high water or low water; we cared nothing about it. The water is about 20 feet deep. We laid it by handling the pipe on the bridge and lowering it therefrom. It is of wrought iron with flange joints. The vertical part was put in position and then we lowered the horizontal part. Before we did that, the diver cleared away a level place for the pipe to lie in. After that was done, having made the bed as level as possible, we lowered the pipe and the diver put it together under the water. The gaskets were covered with lead, and then the diver would come up and take them with him down into the water. I asked if the salt water would not wash off the cement, or at least whatever was used on the gasket, but it seems it did not. The diver would go down with it and fix it, doing the work under water. That pipe has been in existence quite a number of years. With regard to the drip, we hardly ever find anything in the siphon. It is very seldom we find any condensation whatever, although this pipe is in salt water and has been there for years.

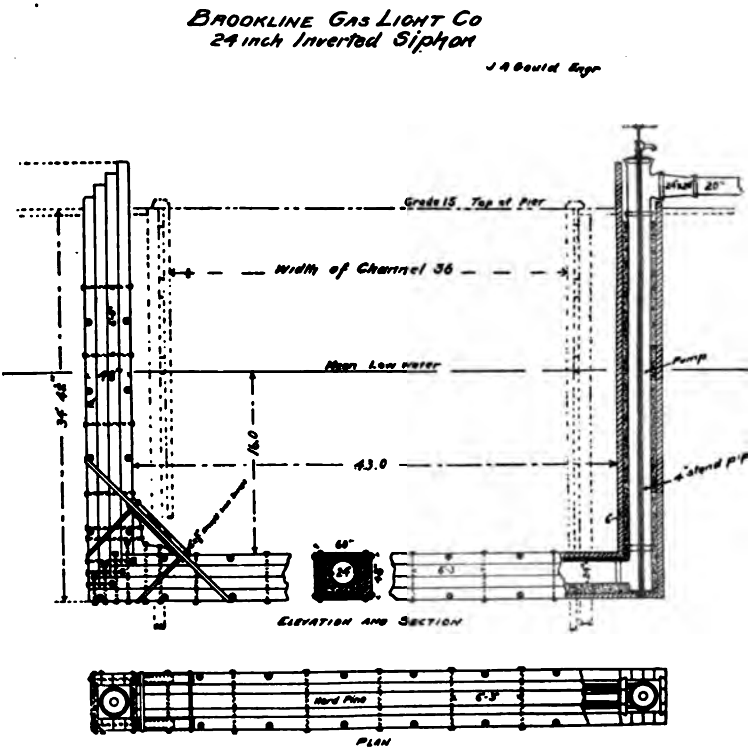
The President — Did I understand you to say it was cast iron or wrought iron, and what size?

Mr. Neal — Wrought iron, and I think, 4 or 6 inch, probably the former. It is not large. The bridge is to be rebuilt very soon and then we shall put in a 6 or 8 inch cast iron pipe siphon.

The President — Does any other gentleman wish to make any remarks on these smaller siphons. If not we will ask Mr. Gould to tell us something about the siphon put in by the Brookline Gas Company, which I had the pleasure of opposing for a long time—not for mechanical reasons, however.

Mr. Gould — In 1895 the Brookline Gas Light Company obtained permission from the proper authorities of the city of Boston, the state of Massachusetts and the National government to lay a 24-inch siphon under Fort Point channel, at Dover street bridge, for the purpose of conveying gas from the city proper to South Boston. The channel at this point is about 700 feet wide, but the draw opening for vessels is only 36 feet wide. The main is a 20-inch cast iron pipe, except the short section at the draw opening, and was laid on existing, or extensions to existing, pile structures built for supporting the water mains, but at the channel of draw opening, the pipe was enlarged to 24-inch, and was laid as an independent siphon under the channel. The siphon was constructed as follows: A substantial box, 60 inches wide and 48 inches deep, on the outside, was built of hard pine timbers, with sides 12 inches thick, and top and bottom 6 inches thick. The timbers were bolted together with $1\frac{1}{4}$-inch bolts, and the angles were stiffened with hackmatack knees and iron bands. The pipe was laid in this box before the top was in place, and all spaces around the pipe were thoroughly filled with American cement concrete. The horizontal portion of this siphon is 51 feet long over all, and the two vertical arms are about 34 feet high. The siphon was built on a wharf on Chelsea creek, about three miles from Dover street bridge, was launched on inclined ways into the water, and then floated by attaching a pontoon to it. On a pleasant Sunday morning, the siphon was towed through seven bridges to a position directly over its final location. The draw pier and wharf had been previously torn away and a trench dredged to receive the siphon, so that the top of the box under the channel should be at least 16

feet below mean low water. The water pipe siphons under this channel are only 15 feet below mean low water, which accounts for the moderate requirements as to depth. The siphon was floated into position at high tide and was quickly lowered into its present position, so that navigation was interrupted by



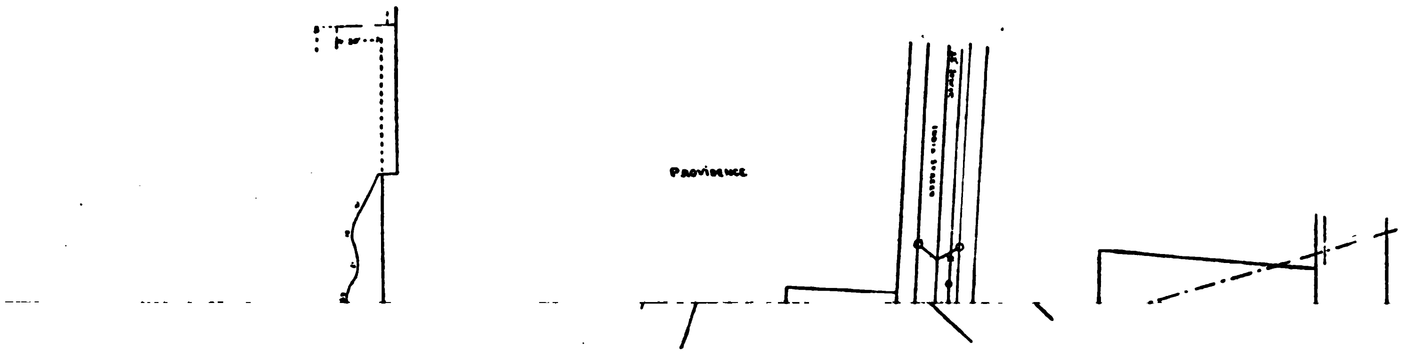
the operation only during the ebbing of one tide. Any condensation or leakage that collects in the siphon is taken care of as follows: The upright and horizontal pipes are connected by tees. On the lower spigot ends of these tees are caps with shallow sockets, 6 inches in diameter. A 4-inch wrought iron pipe sets into one of these sockets, and also extends up through a cap on top of tee at upper end of vertical arm of the siphon. A gas tight joint is made around this standpipe at upper cap, and a few inches of water in the lower socket

will seal off this 4-inch standpipe from all gas from the main. Inside of this 4-inch pipe is placed an artesian well pump, at such a depth as to easily draft any water from bottom of siphon. It is possible to remove this pump at any time for examination or repairs, without interfering with the use of the siphon; but up to the present time the pump has not required any attention or repairs. The siphon was laid so that all condensation collects at one point where the pump is located. This drip receives the condensation from 110 feet of 24-inch pipe, 600 feet of 20-inch pipe and 1,100 feet of 10-inch wrought iron pipe (there being a double line of 10-inch pipe on the bridge over the railroad), and it is never pumped oftener than once a month. In fact, judging from our experience to date, we could safely omit pumping the drip for 6 months. The pipes on bridge and trestle are uncovered, so they make very good condensers. The pipe in the siphon was made 24 inches in diameter so it could be examined on the inside after being laid. This proved a wise precaution in this case owing to the blunder of a man employed by the contractor to launch the siphon. While the siphon was resting on the greased ways, and before the anchor tackle had been attached, he deliberately knocked away the only remaining check on one way while the other arm was firmly anchored, the result being that one half of the structure slid into the water while the other half remained on the wharf. This caused a general wrenching and twisting of the siphon and its apparent destruction, but fortunately it was brought back into its normal shape and was then made water tight by working on the joints from the inside of the pipe. These joints were first caulked with cold lead, then cast iron rings, 22 inches in diameter on inside and $\frac{1}{2}$ inch thick, were placed at all joints showing signs of leakage, and the space between these rings and the pipe was caulked with tarred oakum and cement. This latter operation was done after the siphon had been lowered into its final location and when it was under a maximum head of about 30 feet of water. The contract price of the siphon in place, exclusive of furnishings and laying the pipes in same, was $4,200.

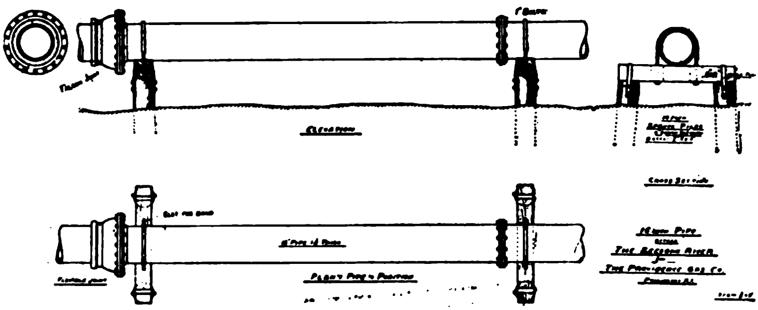
The President — Gentlemen, you will observe a leading up gradually to the largest under water construction we have in New England. This will meet the requirements of fairly large cities. Are there any questions for Mr. Gould? Mr. Gould,

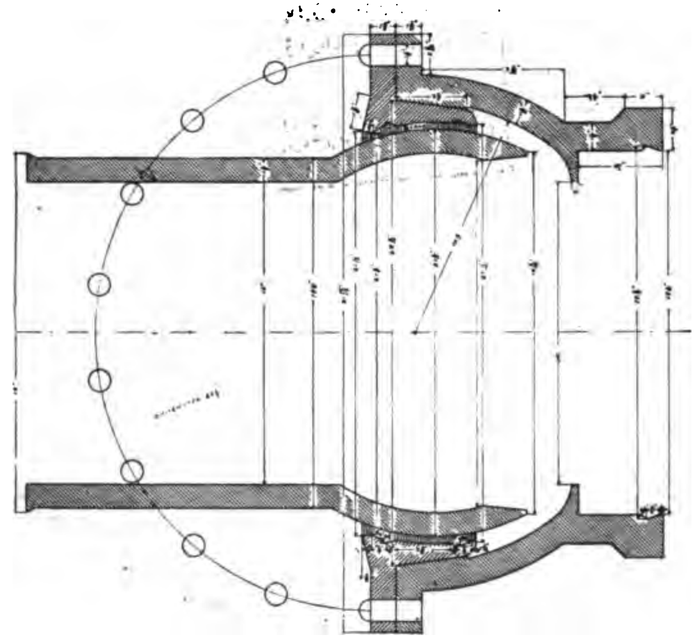
it seems you made your remarks so full that they covered everything. Mr. Slater, may we ask you now to take the matter up with your construction in Providence.

Mr. Slater — Mr. President, I don't know whether you are quite right in saying this is the largest submarine pipe laid in New England. It may be requisite in the first place to explain the reasons making it necessary to lay the pipe across the river. This portion (indicating on a map) represents the city of Providence, this locality is East Providence, and the two stations of the gas works are situated on the west side of what is known as the Seekonk river. Some 20 odd years ago we built a holder over there and supplied it by a portable connection over a drawbridge. The last year or two it became necessary to fill that holder almost every day in the winter, consequently if it were necessary for the draw to be taken up or laid off for a day or two we would be without gas, so we concluded to put a pipe across the river. That location represents a bridge about 1,600 feet long and there is a railroad bridge just below it, and the pipe crosses between the two. This blue print shows the preliminary examinations for the depth of water in the bottom of the river. It was deemed advisable, on account of the varying conditions of the bottom or bed of the river, to dredge out and drive piles. A channel about 12 feet wide was dredged out and piles driven, cut under water, a cross piece put on, the pipe laid on that and the cross pieces strapped down to 12-inch piles. These piles were something like 16 feet apart. The pipe is 16 inches in diameter and 1 inch thick. It was laid in sections, made up in sections of three pipe, and every third joint was a flexible one. This (indicating) represents a cross section of the bed of the river, and the red line represents the pipe as it was laid. We were obliged to put that pipe 25 feet below low tide, for the Government dredged out there to a depth of 25 feet. It is about 60 feet across there, and the line is laid on a 4-ft. grade from one end to the other. By examining the profile you will see the conditions of the bottom, representing stone, sand, gravel, clay, shells and mud, and mud and shells. As I said, the pipe was made up in sections of three lengths of pipe, lead joints, every third joint a flexible one, invented by the contractor and patented. They would swing up a section of this pipe three lengths and drop it on the timbers. Then the diver


PROVIDENCE

went down, lined it up and made his joints. It took him generally about two hours to do that. Then he would come up, get his straps and go down and strap it on, as shown by the other





drawing there. The pipe was put in use the latter part of December and there is hardly any appreciable drip in it. The drip is on the easterly side, and 29 feet below low water. So far it has been a perfect success.

Mr. Allyn—I would like to inquire more particularly about

this flexible joint, if Mr. Slater will describe it. There is a flexible joint in use in Boston.

(Mr. Slater handed Mr. Allyn a circular describing the flexible joint).

The President—Mr. Allyn, I would request you to give that circular back to Mr. Slater so that he may let us have the benefit of its remarks. I want to know something about that flexible joint too.

Mr. Slater.—The circular reads in reference to the point inquired about:

"It does not shut off the opening when it is at its greatest angle. The bell is large and roomy for the water to pass through. All surfaces and flanges are turned. The lead covers a long space on the body of ball insuring its tightness. It is caulked on the inside and outside, and can be caulked any time after being laid, the same as bell and spigot pipes.

"The ring is smaller in diameter than the ball, so it cannot be pulled out after being bolted together without breaking the ring and bell; that is why we term it the double strength ball joint. It will stand as much pressure as the pipe it is made for, and will remain as tight after being caulked. Contractors and divers will find this joint as represented, and easy to connect under water. When ordering joints state the weight per foot of pipe going to be used so as to insure a proper fit. All joints will be made with bell and spigot if not ordered otherwise." It is called the Falcon joint, and was invented and patented by the diver who did this work, Joseph G. Falcon, of Evanston, Ill.

Mr. Sherman—We have had 800 feet of the 16-inch pipe laid under identically the same conditions as represented on that blue print and by the same party some four years ago, and I can state that it gives satisfaction. There is very little drip. We only pump it out once a month. We laid it under the same conditions described by Mr. Slater, on piling and 25 feet below high water. It is a Falcon joint, and the line was put down by the same party that did the Providence work.

Mr. Slater—I think there is the difference that in the Seekonk river the current is very strong, whereas in Mr. Sherman's case there is little or no current.

The President—Mr. Sherman, they are bell joints, with every third one, in your siphon, the Falcon joint?

Mr. Sherman—Yes sir. Those who went over the Shore Line in the old times as they crossed the bridge would see where we laid that pipe. It was just between East Haven and New Haven. Of course, they have diverted the track in the last two years, but all those who entered the city from East Haven would remember seeing the place where we laid the pipe. There is no very great current perhaps, but it is fully as deep as Mr. Slater's place was.

Mr. Slater—I might have stated that when this pipe was laid and connected on the shore ends an air pressure of about 55 pounds to the square inch was put on it and it stood 24 hours without any appreciable variation.

Mr. Sherman—I would say that at the time our pipe was laid a 24-inch water main was also laid on the same piling, and it has proved a success.

Mr. Mckay—Will Mr. Slater give us an idea of the cost per foot of this pipe when laid?

Mr. Slater—We have not got the cost figured up yet, for we have not got all the accounts in. I suppose it will cost in the neighborhood of $24,000 or $25,000. The question was suggested whether we could afford to lay that pipe across there, it cost so much money; but we were obliged to do it so that section of the city would not at any time be left in darkness.

Mr. J. J. Humphreys, Jr.—In this connection I might mention that at Toronto they had a water intake pipe, I think of cast iron, that ran out into the lake a considerable distance. During one of the winter months the ice gathered at the mouth of the intake, the water was pumped out, the pipe floated and became damaged. This is one thing to be thought of in connection with laying large pipes under water. You have to figure what weight they would float. You must have pipes heavy enough to hold down, or strap them down.

The President—That incident is rather interesting. I presume that was the intake for the water works.

Mr. J. J. Humphreys, Jr.—Yes, sir.

Mr. Allyn—I recollect that Mr. Lemoyne, who was formerly connected with Messrs. R. D. Wood & Company, showed me some plans of flexible pipe, it might be called, that they had laid in several cases for water works. Their method at that time was to connect the pipes on a flat boat, and lower them

down as they connected one pipe after another. None of the pipes were put together in sections and lowered as has been described by the other gentlemen. They were simply put together on this flat boat and lowered down into the river, and were all of the flexible joint type.

Mr. Sherman. — The Standard Gas Light Company, of New York City, supply their North Harlem district with a 20-inch Ward joint main laid under the Harlem river. It has been successful, so far as I know about it. And Mr. Vanderpool used a Ward joint across the river opposite his works at Newark, N. J. Perhaps Mr. Allen, of the Allston works, who was superintendent at that time of the Newark works, could give us some points about it.

The President—Will Mr. Woods, of the Standard Company, tell us something about the pipe under the Harlem river?

Mr. Woods.—The 20-inch pipe we have crossing the Harlem river is fitted with the Ward reversible joint, laid, as Mr. Allyn said, from a flat boat. The vertical line was dropped in, and then one length taken after the other, until we got to the other side, a distance of about 600 or 700 feet. It worked all right till a dredge that was operating in the vicinity dropped its anchor pile into it and put 8 feet of it out of business. It took three or four weeks to get it fixed up, and since then it has been all right.

Mr. Hirt.—Referring to the laying of pipes from floats, I remember, some 10 or 12 years ago, I happened to be at a meeting of the Cleveland City Engineers' Club, where a member read a paper saying that he had successfully laid pipes for water works purposes in the winter time on the ice, by cutting a groove through the ice. The pipe was made up of universal joints, lowered as made up till it reached the crib, when crib and pipe were lowered together and anchored.

Mr. Gould.—As the laying of water pipe under water has been mentioned, I might state that several years ago I superintended the laying of 3,600 feet of 6-inch main from Moon Island to Long Island. These were cast iron pipes with the Ward flexible joint. The work was done on a large raft. After four joints had been made up the raft was pulled forward, allowing the pipes to slide off behind on a chute. As this operation continued the pipes trailed behind, like a chain with long links, and dropped into position on the bottom of the bay.

The President. — Mr. Allen, Mr. Sherman suggested that you could tell us something about that underwater pipe connected with the Newark works.

Mr. Allen.—Some years ago, when I was connected with the Newark Company, we had occasion to run two 12-inch parallel pipes across the Passaic river; I think the distance was about 1,500 feet. The work was given out by contract to a Mr. Ward, of New Jersey, who used a special ball and socket pipe. The first thing done was to dredge the river, forming a a trench about 5 feet wide and 10 feet deep. They then undertook to lay the pipes from a float, by connecting two and three lengths together at a time and lowering them overboard, keeping one end of the pipe above water in order to make the lead or ball joint to the next pipe, and so on. The current of the river was so strong, and there were so many steamers going by, that they were obliged to abandon that scheme, after working on it about a week and breaking several lengths of pipe. They then tried another plan. On the opposite side of the river was a marsh. They placed some planks and laid the pipes on rollers, connecting several lengths together, fastened a wire rope to one end and dragged the whole line across the river by means of two horses and a winch. A diver then went down and connected the two 12-inch pipes to two 24-inch flange tees on the vertical pipes; the lower end of these tees formed the two drips. There was a gradual fall in the two lines from the Harrison side over to the Newark side. After the pipes were all in place I think we pumped the drips several times during the 24 hours, getting about a barrel of water every time. After the pipes had been laid three or four months the leakage finally dropped down to a few gallons. I believe today it is practically tight.

The President. — I understand, Mr. Allen, that in getting it down we are to assume that a diver went down and caulked the joints?

Mr. Allen.—No, sir; they were ball and socket joints. He went down and made the final connection at the drip on one side of the river.

The President.—How did you decrease the leakage from a barrel lot to a small quantity?

Mr. Allen.—The leaks filled by themselves, with dirt, etc.

Mr. Sherman — Natural gas at Buffalo is brought into the city across the Niagara river about at Black Rock. I know nothing about the conditions under which the pipe was laid, but I noticed the current at that point in the river was very swift. They had no trouble in getting the pipes round there which supply Buffalo with natural gas from the Canada side.

The President — I assume from what has been said—there is nothing in the negative—that all these pipes are doing their work and have shown no material deterioration. I hear no objection to this statement, so I assume that that is so in every case we have heard from. Any further questions or any discussion?

Mr. Coggeshall. — I have been very much interested in this matter as, at Oak Hill Road, was a bridge under which ran one of our pipes. Some days ago the great flood we had broke the pipe and carried it down the river. I shall run it underneath the channel the coming season.

The President.—I guess you will find as a rule it will be safer. Anything more, gentlemen? If not, we will pass on to the next branch of the subject, which will be tunnels; and we will have the pleasure of hearing from Mr. Hirt again.

Mr. Hirt.—The location of our pipe line and connections with the different gas companies necessitated the crossing of the river at three different places, namely: One 54-inch siphon at the Malden bridge; one 42-inch siphon at the Charlestown new bridge; and one 48-inch siphon at the River street bridge. In going through the customary form of application necessary for permits we found that the Malden bridge was to be rebuilt, and for the present, only temporary; therefore, we could not put in the ordinary wooden box siphon. The Charlestown bridge being a new one, the authorities did not care to have it disfigured with a wooden siphon, and the River street bridge was also likely to be rebuilt with some kind of ornamental design, being as it is on the Cambridge Park Way. All things being taken into consideration, we found it would be better to put our siphons through the solid material under the bed of the river. In looking into the different modes of construction of tunnels for this kind of work, it was, after careful consideration, decided to put in wood lined tunnels. The three tunnels were built on the same principle, which is as follows: A vertical shaft was

sunk the proper depth, and until we met a good foundation, to carry the weight of the vertical pipe. The horizontal tunnel is started with the necessary air pressure to keep the water out, and is built up as fast as it is pierced in the following manner: The tunneling is carried on from 8 to 10 inches at a time, and as soon as room enough is made the wooden pieces, which are cut segmental to suit the radius of the tunnel, are fitted and placed in position. These segmental pieces are not over 12 inches long and are spiked together, breaking joints in a similar way for the building of a vertical stack. As the wood is dry when it is put in it becomes soaked with water, thereby swelling and making quite a tight tunnel. The whole of the tunnel is built in this manner, and but a small amount of leakage took place, and this, when the air pressure was taken off, could be easily pumped out, and once it was sufficiently dry the men could work in it and lay the pipe. The cast iron pipes were lowered and laid concentric to the tunnel, cement jointed and grouted all around the external surface of the pipe. In the Malden bridge tunnel we used taper bored joints, and crowded the grouting around the outside of the pipe by drilling holes in the upper part of the pipes when they were laid. From that point we made pipe connection with a 3-inch pipe to the surface of the street, where it was in turn connected with the box in which the grouting was poured, and was by gravity run down into the tunnel, filling the space between the pipes and wooden tunnel very satisfactorily; the average head being not less than 60 feet, we had sufficient pressure to do the work well. The three tunnels have been built in the same manner. and we feel that we have a piece of work which cannot be disturbed by ice or boats; and in all cases we went deep enough to keep away from the pile driver. This construction of pipes laid in the tunnel has brought forth an unexpected action; that is, the sweating of the pipes. We find that the effect of the outside temperature seems to govern the amount of water in the drip-pots on each end, and in some cases have pumped 16 barrels of water per day out of the Malden bridge tunnel (which is 850 feet long) and about 2 or 3 barrels out of the Charlestown bridge tunnel (which is only 260 feet long). The River street tunnel not being finished, cannot be reported on. We are, however, able to state that the quantity of water

mentioned above is diminishing daily, and it looks as though it will finally come down to a standard amount every day. We also have at the Charles river bridge siphon a peculiar freezing action on our pump pipe. This tunnel is 260 feet long, while the exposed steel riveted mains are 360 feet long, connecting the siphon with the street main. The gas flowing in this thin steel pipe towards the siphon suffers a considerable reduction in temperature, due to external cold air, in cold weather. This cold gas, on flowing down the vertical to the tunnel, absorbs heat from the pump pipe, causing the water in it to freeze to a depth of 20 feet below the surface of the street. We evidently can overcome this difficulty by keeping the pipe empty. Next winter we may cover the steel pipes leading towards the siphon, to prevent this cooling effect on the gas. The pump pipe is similar to the one Mr. Gould is using at the Broadway siphon, which has been explained to you.

The President — Any further questions? I hope, gentlemen, I have succeeded in filling the gill, the pint, the quart and the gallon people. If there are no further questions, I am sure it is not necessary for any one to move a vote of thanks to these gentlemen, but I will put it to you at once. All those in favor of having the Chair convey the thanks of the Association to these gentlemen please say, "Aye." (The response was a rousing "Aye.") Mr. Coffin, please accept the thanks of the Association; and Mr. Gould, Mr. Slater and Mr. Hirt also. We have all been very much interested.

Completing the Discussion on Oven and Retort House Construction and Results.

The President — I was very much disappointed yesterday because I felt that something was missing. I am sorry that the gentleman whom I am going to call upon was not then here, for his own sake as well as for ours; but as I think he can give us some very valuable information, in that he has very lately done some active work in retort house construction, I am going to call on Mr. A. B. Slater, Jr., even before he has had time to take breath. Mr. Slater—

Mr. A. B. Slater, Jr. — Mr. President, the only construction of the sort that I have had in hand recently was to rebuild a small retort house that it became necessary to renew

on account of failure of the foundations as originally put in. The construction, therefore, was practically a matter of repair. We took down the old building, left the stacks of benches as they were, put in new foundations and then put up the new building. The form of construction used was steel frame construction, and as the retort house is really a continuation of another building, or what was another part of the same original building, we used brick filling to preserve a reasonable correspondence of outside appearance. The original building had the old-fashioned roof, commonly known as the gas house truss, made of light iron, and the trusses put in very close together in order to have the carrying strength necessary. In the present structure, the building being 110 feet long by about 65 feet wide, there are but four trusses between the ends, and those trusses rest upon the main columns, the roofing being carried by trussed purlins, spanning from truss to truss through the length of the building. The roofing was of the Melan construction (expanded metal and concrete) about 4 inches thick. The main trusses are 22 feet apart on centers, and the trussed purlins are about $9\frac{1}{2}$ feet apart, and there is no other support for the expanded metal construction than those trussed purlins and the rafters of the main trusses. We also put a slate covering on the outside of that, being the same slate covering that was used on the original building. The steel frame construction gave us an excellent opportunity for attaching our brackets to the lattice struts inside of the building, for supporting the mains from the take-offs to the exhauster room. In the side walls of the building we placed the usual doors, similar to what they were in the old building; but above them and near the jet we placed a row of wire glass windows about 5 feet square, and there were two to each panel, the panels being about 22 feet. Those windows were steel pivot sash. They are so arranged as to be controlled from the floor, in order to give good light and ventilation.

The President—Mr. Slater, may we ask you something about the contents of the building?

Mr. A. B. Slater, Jr.—The benches?

The President—Yes, the benches and charging and drawing machinery.

Mr. A. B. Slater, Jr.—They are the same old benches that were there before. The stacks run crosswise of the building.

The only change that we made with regard to them was simply to put our take-off main on the opposite side of the building from what it had been, so that, as we usually work the benches nearest to the take-off pipes, it enabled us to put the bulk of future work on the arches that theretofore had had the least work.

The President—May I ask were you using machinery for charging and discharging your retorts?

Mr. A. B. Slater, Jr.—No, sir; it is all hand work. The building simply contains two stacks of 10 benches of 6's each, and, being arranged crosswise of the building, they are not well placed for using machinery. In fact, the sendout from that works is not yet large enough to warrant the installation of machinery for operating those benches.

The President—Gentlemen, have you any questions to ask Mr. Slater? I don't believe there are many retort houses that have used the steel construction with the filling of brick, although such buildings can be seen at Everett.

Mr. A. B. Slater, Jr.—One point I would mention on the matter of brick filling, is that it seems a common practice in the case of steel frame buildings for manufacturing purposes to leave the steel work exposed in the face of the building on the outside. That seems to me to be a very poor thing to do. In our case we simply pilastered around those columns on the outside, so there would be no opening for the weather to work in between the brick work and the steel work.

The President—I assume also that would tend to prevent expansion and contraction, Mr. Slater, would it not, as well as corrosion?

Mr. A. B. Slater, Jr.—Yes, sir.

Mr. J. J. Humphreys, Jr.—I would like to ask the method used by Mr. Slater to fasten the slates to the cement roofing?

Mr. A. B Slater, Jr.—The expanded metal work was put in by first putting a floor of wood, "centering," we call it, between the rafters and purlins—the top face of the wood work flush with the top surface of the rafters and purlins—and on that was laid an oiled paper to prevent the wood from sticking to the cement. Then the expanded metal was laid and very strongly fastened together, the sheets lapping each other considerably. Then a coarse Portland cement and cinder

concrete was laid on. While that was being laid by means of hooks the sheets of expanded metal were shaken up into the body of the cement, so that the metal was entirely covered on the under side. Then, on the body. of course, there was a finish coat of Portland cement put on the outside, and then, before that had set too hard, the slate were placed and simply nailed on with galvanized nails, as is ordinarily done to a wooden roof. The cement as laid for such a purpose would not set so hard inside two weeks but what the slate could be satisfactorily nailed to it. In fact, this roof, where the slating was first begun, had set quite two weeks, but there was no trouble whatever in nailing the slate to the cement, just the same as would be done to a wooden roof. After the cement work had been set long enough to gain proper strength, all the wood work was entirely removed.

The President—May I ask if there is any cement between the slates?

Mr. A. B. Slater, Jr.—None, except a little spot of roofer's cement, as is usually applied, to keep the slate from getting a bad bearing on account of lumps in the slate. We used very large slate, and the surfaces were not as smooth as would be found in the first quality of Monson slate, for instance. These slates were very large; I believe they were 14 inches by 28 inches, having been made in that large size to accommodate the space between the purlins on the original roof, from which they were taken and applied to this roof. But there was no Portland or other hard setting cement applied between the slates; they were applied exactly as would be done in case of a wooden roof.

The Secretary—I would like to ask Mr. Slater to give roughly the approximate relative cost between the skeleton construction and solid brick for the wall.

Mr. A. B. Slater, Jr.—That depends so largely on the condition of the iron work that it would have to be considered for some specific time; but in general I should say that the cost of the steel construction, which includes the roof trusses, of course, with the columns for the side walls, made the whole building cost approximately the same as a building with all brick walls and an iron frame roof put on top.

Mr. Macmun—I would like to ask Mr. Slater with what he is going to fasten his slates in the future in case of repairs?

Mr. A. B. Slater, Jr.—The slate as at present nailed on had the nails driven into the cement, and the nails are so protected by the cement that there is almost no possible chance for corrosion of the nails to allow the slate to get loose, excepting simply where the nails are in the slate, and the slates are so long and have so long a lap that we don't anticipate the necessity of any repairs. But should such become necessary I should, from the experience of others who have done similar things, expect no serious trouble in renewing the slate with an ordinary good quality of steel nails. In fact, even the galvanized nails have been used for repairs on a similar roof that was over five years' old. I don't know but that is apparently to say that Portland cement does not set very hard, but that has been done in fact, and I suppose the cinder body of the concrete explains it.

The President—Mr. Slater, pardon me for smiling, but I am a little struck with the fact that you quote the experience of some others who have had to repair their roofs. I think, with the way in which you did the work, undoubtedly you will have no repairs.

Mr. A. B. Slater, Jr.—I should say that those repairs of which I speak were caused by the falling of the top of a chimney on the roof and crushing the slate.

The President—The gentleman is now perfectly justified in his statement in regard to the permanent quality of the work of this roof. I am sure the Association will bear me out in giving the thanks of the Association to Mr. Slater. I think he has come over here at considerable personal inconvenience. The very fact that he was not here yesterday and was not with us last night I think shows that. Mr. Slater, we are indebted to you for coming over and giving us these remarks. Before we go to another subject—it is getting a little late I know—with your permission we will try the Question Box, apropos of retorts and retort houses.

The Secretary—One of the questions is:

"In double stacks of retorts which arrangement is preferable — to have the benches set back-to-back, or facing each other, with operating floor between?

The President—Is Mr. Snow, of Holyoke, here?

Mr. Snow—I don't know that I can advance any arguments to tell which way is preferable. That is one of the questions that frequently come up in gas works' experience that each man must answer for himself, according to his own likes, perhaps; also according to the conditions. I suppose I have been called upon because our arrangement is with two single stacks with the operating floor between them. Our retort house as originally laid out had a double stack. The time came when we had to build over the stack, and it seemed best for our purposes to divide that up into two. We have been very glad since that we did so. The arrangement is very satisfactory. There are a few points that strike us that that arrangement is preferable over the old style. It was surprising when we first had the work done to see how large our retort house appeared; the house seemed to be 50 per cent. larger than it was before. It puts all your available room into one space. While we had a working space between the old bench and the walls of about 20 feet, we get something over 31 feet now between the two benches. All the work is under the foreman's eye at one time. There is an advantage in seeing that work is going on right. Any stopped or leaking standpipe or mouthpiece is more apt to be observed quickly. Then, too, with this arrangement is another important feature that is very desirable, in that we can get to all the flues quickly and easily. We can get to the horizontal flue under the bottom retort both from the front and rear of the stack, which we have found to be a very decided advantage. There are, of course, a number of arguments against that style of construction. Two stacks will undoubtedly cost more than your double stack. You will have thicker rear walls to make up for having the benches back to back. But in our case we certainly feel that it has not been money thrown away. I don't know that we have been able to make gas any cheaper per 1,000 with this arrangement than with the other arrangement; but we can make it just as cheap.

The President—May I ask Mr. Snow if anything struck him in regard to the ventilation?

Mr. Snow—I didn't speak of that, because our old arrangement was short chimneys, which I think is not a well accepted arrangement. In our case the chimneys all came out in the building, and at certain conditions of temperature and wind the inside of that retort house was simply fearful. I never

could see how the men stood it. I could not go in there and live apparently half an hour. The gases from the chimney seemed to settle right down on the floor. As regards the ventilation from ordinary smoke and dust, it is better under our present conditions than under the double stack back-to-back.

The President—I have my mind on one man, but I am not looking at him, whom I think can speak interestingly to us on this subject. Come on, Mr. Wood, let's hear something about it.

Mr. Wood—Mr. President, I think Mr. Snow hit it right in his opening remarks and that it is purely a local issue. He has also demonstrated by his remarks that what is one man's meat is another man's poison, because I have known of cases where the change has been made and the stacks split, which were formerly double, back-to-back, put on the side of the house, facing in. Where under the old arrangement the ventilation was perfect and working conditions were of the best, with the stacks facing each other such a set of currents and counter currents was set up that it was almost impossible for the men to work, especially if charges should not happen to be well baked. This was due to the smoke and steam from the drawing and the quenching of the coke down below in a 2-story house. In looking at it theoretically, and considering the questions of radiation, ventilation and economy of construction and floor space, a man would naturally say that the back-to-back would be the better construction. You really gain no floor space with single stacks and you put the men between two fires. Most of you know how hot it is in front of a stack at the side wall, even, if you have from 16 to 20 feet between the bench and the wall itself. It generally surprises people who are not familiar with the business to put their hands on that wall. If you concentrate those two fires and put the men between them to work, unless the distance is more than doubled, which it is not generally, because, as Mr. Snow says, you have to thicken the back walls and also leave a space for repairs between the back wall and the wall of the house, it seems to me that it is not as comfortable a place to work in as it is under the old conditions. It is also a question largely of how the coal and coke are to be handled, if it is to be manual labor or whether a large amount of machinery is to be employed, and, of course, the inclined question puts an altogether new light

on the whole matter. As I understand it they were not successful in their first installations where the benches were built double, the stacks double, and the inclined charging mouthpieces were brought up through the brick work at the center of the stack. That, I believe, was the first arrangement and practical difficulties caused them to abandon that system. In the case of inclines a single stack seems to be a necessity.

The President—Mr. Wood, do you think it is a fair statement that the principal advantage in splitting the stacks is in having a single conveying machinery plant and having concentration of all your charging and drawing machinery?

Mr. Wood—I should say that was the great advantage.

Mr. Snow—Mr. President, just one further word regarding the heat between the stacks. If the works got to the point where they sent out more or as much gas in summer as they do in winter I think our arrangement would be decidedly uncomfortable; but in smaller works, as we have always been able to do since we have had the arrangement, by a little managing, always having our summer work one side of the house, the retort house is more comfortable now than it used to be. You can get farther away from the fire by having that 31 foot space in the center against the 21 between the bench walls and the walls of the building under the old arrangement.

Mr. J. J. Humphreys, Jr.—As a matter of economy, the increasing radiating surfaces of the benches not back-to-back would work against that arrangement decidedly.

The President—In reply to a suggestion, Mr. Snow has said, in his case, he could not notice any difference as regards the cost of gas. I assume from that he means there was practically little difference in the amount of coke used. Is that correct, Mr. Snow?

Mr. Snow—Practically you don't notice it. Theoretically the other position is sound, I think.

The President—It may be a very far suggestion, but possibly keeping the heat in the building may have something to do with offsetting the apparent disadvantage in not having the stacks back-to-back.

Mr. Benj. J. Allen, of Allston, Mass., read the following paper entitled

Some Notes on Oil and Tar Burning.

This is an old subject which you are all no doubt familiar with, yet there may be some points of interest brought out in discussion later on.

The bench fuel used at the Allston Station of the Brookline Company for the past six years has been principally a cheap grade of fuel oil. Owing to the late advance in the price, and the scarcity of such material, it was found necessary to find a substitute at less cost.

Our fixing benches are mostly of the regenerative type—namely, Laclede and Weber settings. with a few of the old-style furnaces; but in every case six retorts constitute a bench.

The large furnace and generator of our benches are filled with ashes and the openings on top of generator arch are covered with tiles. This was done to prevent any explosive mixture collecting in that part of the bench while burning fuel oil.

It is necessary with our process to maintain a very even heat on the retorts in order to obtain the best results. In burning this oil we have been using a burner, manufactured by the Standard Oil Fuel Burner Company, of Watertown, N. Y., as shown in Fig. 1. This was attached to the front of the bench between, and level with, the bottom of the two lower retorts. We pump the oil from storage tanks into a small overhead supply tank, fastened to wall outside of building, and elevated about 20 feet above the floor. This gives a sufficient and uniform pressure at the burner. The air supply of about 16 inches water pressure was furnished by the same blower that is used for the water gas generators. Although there was considerable pulsation and variation of air pressure, especially when the blast was put on and taken off the generators, we experienced no difficulty in burning fuel oils. However, in order to overcome this variation in air pressure, we connected up an independent blower and engine, and after several months' run we abandoned this plan and returned to the original one, as the advantage gained was not worth the extra cost in steam, oil and repairs.

With the light oil we can maintain a very uniform heat on benches, and could fix 100,000 cubic feet of carburetted water gas per retort in 24 hours, using $\frac{3}{4}$ gallon fuel oil per 1,000

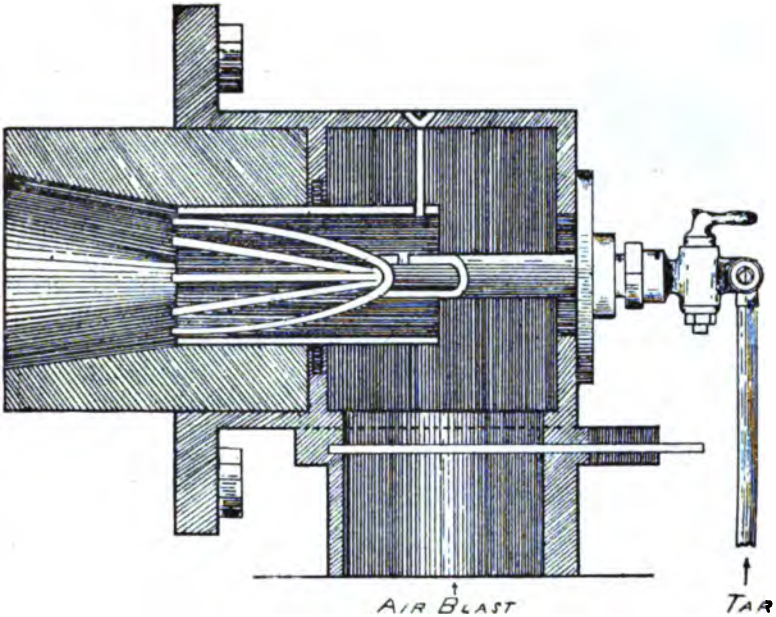


Fig. 1.—Standard Oil Fuel Burner, Watertown, N. Y.

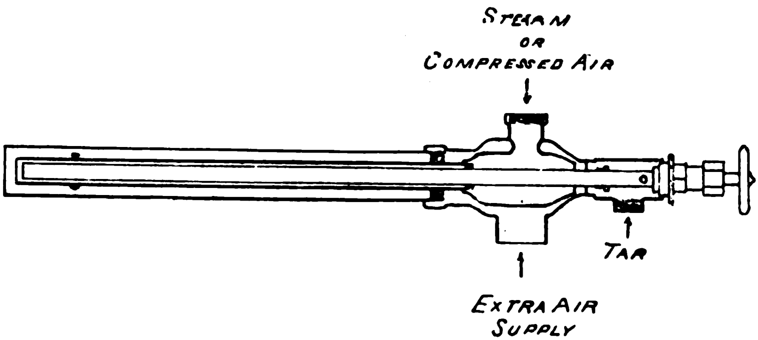


Fig. 2.—Make Unknown.

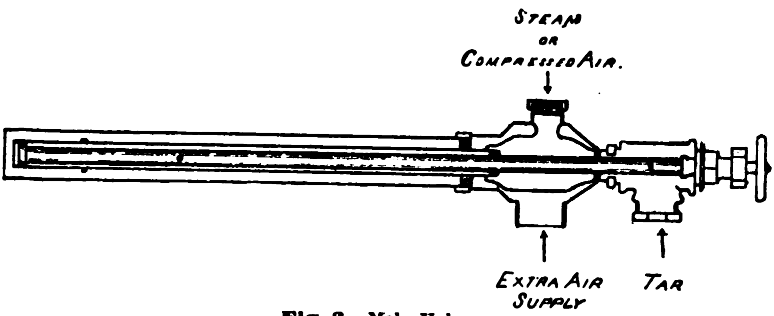


Fig. 3.—Make Unknown.

cubic feet of purified gas. One man could attend to all our 22 fires and regulate the feed to the 66 through retorts.

In using this light grade of oil we found as a general rule that it was not necessary to heat it, except in a long continuation of zero weather. For that purpose, we have a small steam coil in bottom of storage tank. We have made several cold tests of the oil and found that it would thicken at about 15° above zero.

We found by taking the lighter grade only of our water gas tar, that we could burn it with nearly as good results as above mentioned, using the same burner and irregular blast. This put a commercial value on our light tar, nearly equal to the fuel oil which we were obliged to buy. The heavy grade of our water gas tar contains more or less water. Its quantity was too small to justify a water separating plant, so that we dispose of it by mixing it with the bituminous coal and burning it under Heine boilers with the Hawley down-draft furnace.

In January, 1899, we started to use a very heavy grade of fuel oil, and, in order to obtain the best results, we built a sheet iron tank 14 by 16 feet, with a coil of about 190 feet of $1\frac{1}{2}$-inch steam pipe, which was placed inside of tank, about 5 inches from the bottom. This was connected to the steam exhaust of a small pump, and the oil discharge of pump was connected to small compressing tank, 10 inches by 24 inches.

On the latter was a 50 pound pressure gauge, a thermometer and a relief valve with outlet to suction pipe from main tank. This entire plant was situated 200 feet from retort house and near railroad siding. In handling this heavy grade of oil it was necessary to keep it at a temperature of 100°, and force it to the burner under pressure of 15 to 20 pounds, where it was consumed by using the same burner as in the other two cases, and with the same results, excepting we were obliged to admit a little more air in order to obtain a perfect combustion. The connections of both the above plants are shown in Figs. 9 and 10.

A few months ago we started to burn coal tar and made some experiments with various burners, using steam and compressed air. The writer wishes it understood that he does not want to praise or cry down any particular burner, but simply wants to state his own experience and let it go for what it is

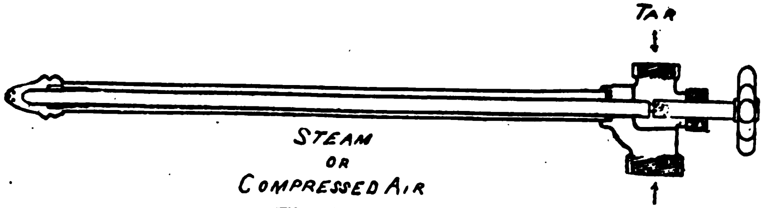


Fig. 4.—Gilbert & Barker.

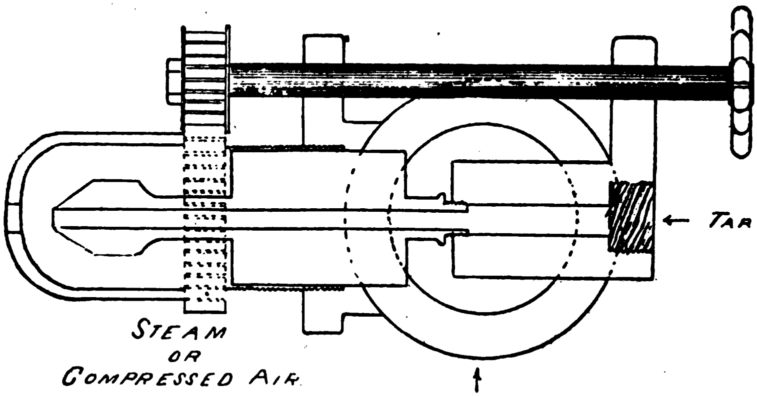


Fig. .—Gilbert & Barker

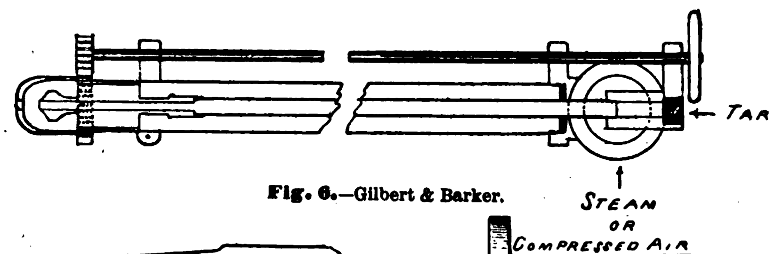


Fig. 6.—Gilbert & Barker.

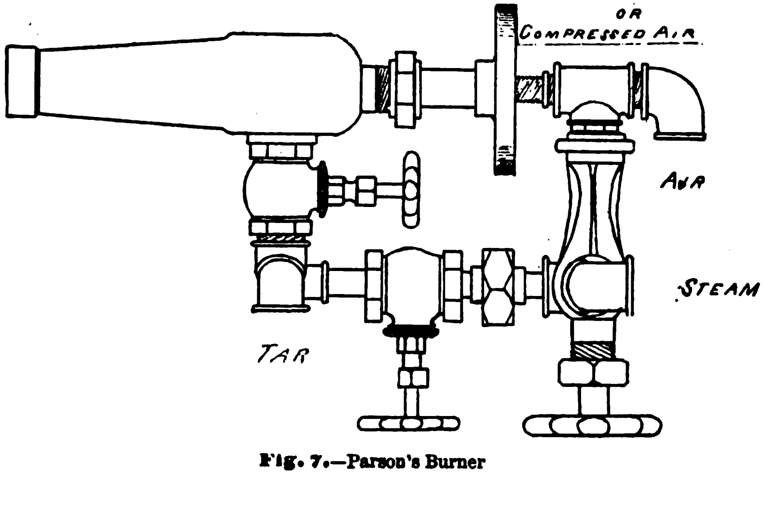


Fig. 7.—Parson's Burner

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worth. There are plenty of good burners on the market, and there are men who will differ with the writer in his experience with these that I mention.

In our first experiment of burning coal gas tar we used the Standard oil fuel burner with the 16 inch irregular blast, as before described. After heating the tar up to about 100°, and handling it as shown in Fig. 10, we varied the pressure at the burner at times from 5 to 25 pounds, in order to observe the effect in combustion chamber and flues of bench, etc. We soon came to the conclusion that our old way of burning fuel oil would not be satisfactory for coal tar, as it required the combined efforts of three men to attend and adjust a few burners. For this reason we were prompted to make a few experiments.

We had on hand an old 16-inch Mackenzie exhauster, also a small air compressor. Both of these we connected up with a small engine in the retort house, and in this way could maintain a constant air pressure of about 20 inches, or a pressure of about 25 pounds of compressed air, and could use one or both. Our next trouble came with the spraying fork, and small openings in the burner; they were continually clogging up. We enlarged the openings and also drilled a small ½-inch hole in back of burner and put in a steam jet, which remedied that trouble to some extent. We then found that our heats on bench commenced to drop, owing to the excessive amount of air and steam admitted to the combustion chamber; this also caused considerable pressure around the retorts, so we were obliged to carry more pressure inside in order to keep the furnace gases from forcing their way through the small cracks in the retorts.

As I said before, the furnace and generator compartments of these benches were filled with ashes. There was no coke fire to ignite the tar; we depended on the heat of the bench itself.

Our next experiment was with two burners, which were similar in construction, as shown in Figs. 2 and 3. I could not find out the manufacturer's name of either of them; they were some old burners we had on hand. We fitted them up on two of the above mentioned benches, and tried each with steam and compressed air; in both cases they worked fairly well. The burner with a small button

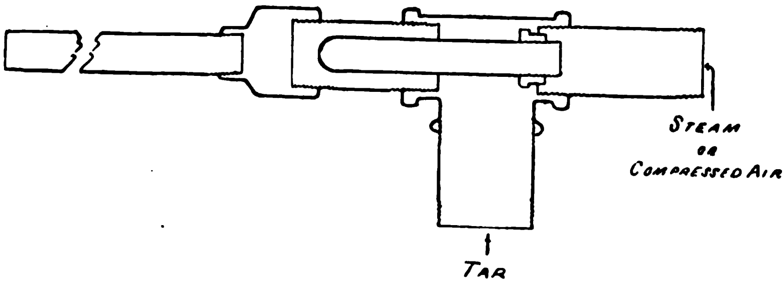


Fig. 8.—New Haven Burner.

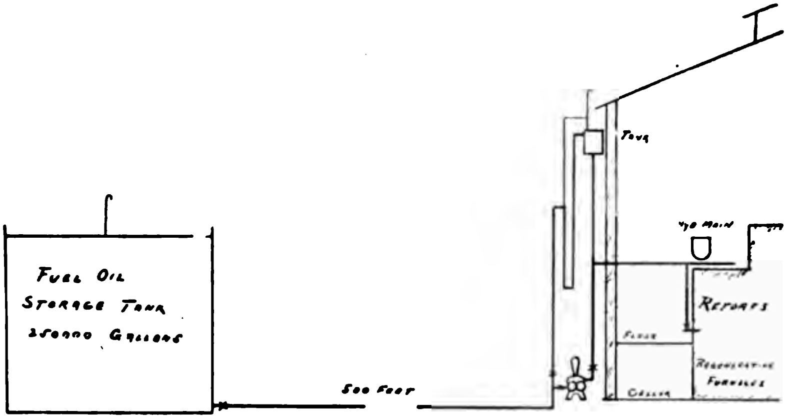


Fig. 9.

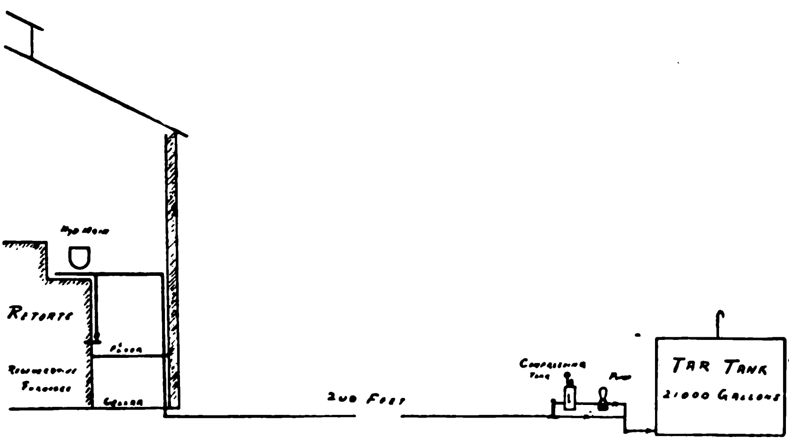


Fig. 10.

on extreme end of inside pipe made a better spray and did not give us as much trouble by choking up as the other one did. We ran these burners several days and were obliged to take them off occasionally and clean them out. We carried a better heat on benches with these burners using compressed air than with steam. We ran them with 20 pounds air pressure and 25 pounds tar pressure.

We next took a high pressure burner, made by Messrs. Gilbert & Barker, as shown in Fig. 4, and subjected it to the same tests as the last two. In this case we found it worked better with 100 pounds steam pressure, as the small openings at the extreme end would continually clog up while using compressed air. We could not increase the latter pressure over 25 pounds with the compressor we had.

We then took another of the Gilbert & Barker burners, as shown in Fig. 5, which we received from the Boston Gas Company, and tried that in three different ways: First, with the 20 inch air blast, then with 25 pounds compressed air, and finally with 100 pounds steam pressure. We found this sprayed the tar very nicely in each case, but the fuel burned close to the end of the burner. The nozzle was so short that it would not throw the tar far enough into the bench, but would burn right in the opening of the wall. To overcome that trouble we put on a piece of 3-inch pipe, but found that was not satisfactory as it would carbon up too fast. We sent for another burner, with an 18-inch nozzle, as shown in Fig. 6. We gave this the same tests that the others had. Here we met with another trouble. The gears and adjustable cap at the end of burner became so hot, and clogged with carbon, that we could not adjust it except with the valves on main pipes in front of bench.

Our next burner we received from the Bay State Gas Company, of Boston. It is known as the Parson burner, and is shown in Fig. 7. This we tried with both steam and compressed air, and found that it worked better with steam.

Our next test was with a very simple burner, which we received from the New Haven Gas Company. This is shown in Fig. 8. It consists of five short nipples, one tee, a reducer and bushing. This we tried with steam only and found that it worked quite satisfactorily.

A few weeks ago we removed the ashes from the furnace and generator compartments of some of our benches and changed

over on to coke as fuel, saving our fuel oil and tar in reserve for future use. This gave us a chance to repeat some of the experiments with various burners using steam only. We took one bench and carried a small coke fire, just enough to ignite the tar. The general results with the burners were about the same, although we found that this small coke fire was an improvement over the other way, as there proved to be a better combustion and a more uniform heat. The amount of coke we used was very small. Under existing circumstances we were obliged to postpone furtner experiments until some future time.

The following table will show the analysis of the furnace gases taken from bench flues while some of the burners were working at their best.

Assuming there was a perfect combustion while burning fuel oil with burner No. 1, with 16-inch air blast, in this case the flue gases would probably show about 14.4 CO_2 and 85.6 N_2; taking the same burner for coal tar with 100 pounds pressure of superheated steam, the gases should be about 18.6 CO_2 and 81.4 N_2. Taking these figures in comparison with the above table it will be seen that there was not a *perfect* combustion in any case.

After these various experiments we concluded for the present we would use the simpler New Haven burner, with dry steam, when burning coal tar, as this burner requires as little attention as any of them.

Should we at any time wish to use compressed air, we would put in a number of New York or Westinghouse air compressors, similar to those used on a locomotive, fastening them on the retort house wall, and run one or more as the occasion required. We think this would be the most simple and inexpensive plant and could be run at a minimum cost. With such a plant we would be in better shape to experiment with the other burners now on the market.

The question of disposing of our tar to the best advantage will be one of interest as the production of the same increases. It may be well for our friends, the producers, as well as the fuel oil consumers, to look again at this old subject.

Discussion.

The President — I think you will agree with me that Mr. Allen has taken this up in a logical and very thorough way, and he will make it that much easier for some of the other

members of the Association to take the matter up (which is a very important thing for all), and avoid some of the experiments, and possibly give us experience next year of the perfect combustion of the perfect burner. Are there any questions?

Mr. Coggeshall — I should like to ask Mr. Allen the number of gallons of tar used in the 24 hours with the New Haven burner?

Mr. Allen — Unfortunately we did not measure the tar during those tests. The meter that we had been using was out of order and we sent it away to be repaired. But of course we would use more tar than we would while burning light fuel oils.

Mr. McKay — Mr. President, a partial answer can be given to the question as to amount of tar that can be burned in 24 hours. Mr. Allen referred to one burner as having been supplied from the Bay State gas works, the Parson burner, and with those burners in use under our boilers in one year we burned about 500,000 gallons of tar. We have used these burners under several kinds of boilers. But I remember that when we were using them under the Hazelton boiler, with three openings in the furnace, with three burners in use, we generated all the steam needed for our entire works. We burned in one day of 24 hours 3,000 gallons with three burners. We burned two-thirds of a gallon of tar per minute per burner, and three-quarters of a gallon per 1,000 feet of gas, made and furnished all the steam used in the works, that is, with about 110 pounds steam pressure. We had the burner arranged so that we could turn steam in to clean out any clogging that occurred.

The President — I want to add to what Mr. McKay has said, as a result of that work, we raised the selling price ot tar half a cent a gallon. Would other gentlemen like to say something about this? Mr. Sherman, you have the best burner, apparently.

Mr. Sherman — I made some remarks on this question at the last meeting. Then we could not sell our tar, but now we have a good demand for the coal gas tar and coke, but we are unable to get a satisfactory price for our oil gas tar. All we are offered for it is from 35 to 50 cents a barrel. So we are burning it successfully in our retort furnaces. Three barrels take the place of 72 bushels of coke. Of course each one of

Burn'r	FUEL	USED	CO_2	O_2	III.	CO	CH_4	H_2	N_2	REMARKS
No. 1	Light Fuel Oil	16 inch blast	14.2	1 1	.2	.5	. . .	8.4	75.6	Furnace filled with ashes
" 1	Water gas tar	16 inch blast	15.2	.4	. .	. .	1.0	.7	82.7	" " " "
" 2	Coal gas tar	100 lbs. dry steam	11.30	.80	2 70	1.39	3.34	7.04	73.43	" " " "
" 3	" " "	50 lbs. comp. air	9.05	4.60	.90	1.42	3.72	7.31	73.00	" " " "
" 1	" " "	100 lbs dry steam	10.5	9 2	. .	. .	. . .	.7	79.6	Small coke fire
" 1	" " "	100 lbs. S. H. steam	16.5	2.6	. .	. .	. . .	1.4	79.5	" " "
" 8	" " "	100 lbs. S. H. "	10.5	7.2	. .	. .	. . .	6.6	75.7	" " "

you can figure up what the coke is worth, but at our figuring of 6 cents a bushel, it brings the oil tar up to a value of $1.44 a barrel.

The President — Perhaps Mr. McKay can give us the relative value of the tar as compared with coal at the Bay State works. It is something over 2 cents a gallon, is it not, Mr. McKay?

Mr. McKay — Yes. I think it is higher than that. There is a little uncertainty as to the exact relation, because, of course, there is a variation in the price of fuel.

The President — I merely suggest that, Mr. Sherman, to give you the contrast between your retorts and tar used under boilers.

Mr. Sherman — This oil tar is from our heavy gas oil, of 35 gravity.

The President — And it is used under your retorts, as I understand?

Mr. Sherman — We use it under our retorts very successfully.

Mr. Prichard — We had some oil gas tar that had been accumulating for a year or two in the bottom of an old holder which we use for a relief holder, and I started this fall to find its value as compared with coal, burning it under the boilers of the electric station. We did not adopt either of the burners that have been shown here, and I should have been glad to have had ours in competition, if I had known it—not that there was anything novel about it. It was on the prinicple ot the common atomizer. Two tubes met at the end, one with steam and the other with tar in. It worked very nicely. We put a burner in each corner of the furnace, directed towards the opposite corner, so that they discharged across each other diagonally. The results obtained were that our oil gas tar was worth 80 cents per 50 gallons, as against steam coal at $2.85. It does not strike me that was doing quite as well as Mr. Sherman, but if coal had cost us twice as much, the tar would have been worth $1.60 per barrel.

The President — Of course it will occur to everyone that a burner for water gas tar and a burner for coal gas tar must be of entirely different design. You will find greater difficulty in burning coal gas tar than you will with water gas tar. I

would like to ask Mr. Prichard what proportion of water there was in his water gas tar.

Mr. Prichard — I could not tell. We only had a limited amount of tar, but there was quite an amount of water. We settled it as well as we were able to by giving it time and heat, but nevertheless there were quite a good many moments when we were burning water apparently.

The President — I am sorry to bring that question out, Mr. Prichard, but we are selling our tar and we value it very much higher than you do. I wanted to bring that fact out about the water. I want now to ask Mr. McKay to bring out still stronger as to what the probable percentage of water is in the tar that he burns.

Mr. McKay — The most recent analyses that we have made of it show so much less than one per cent. that we consider there is no water in it.

The President — I knew the reply before I asked the question.

Mr. Sherman — I should say, regarding the water gas tar that we sold, we were limited to one per cent of water.

Mr. Prichard — It would be very interesting to know the exact process of getting rid of the water. We have all tried at it.

The President — I don't know whether Mr. McKay considers it a secret process or not. You will have to leave it with him.

Mr. McKay — We found a great many vagaries in the tar, in the way it handles itself in certain tanks. Starting with a unit of settling tank capacity, we found that as we went to heavier grades of oil for enriching our gas and, therefore, increased the amount of tar we had to handle, we had to increase our settling capacity almost four fold—that is, to four units. Then we improved on our separating system, on the separating effect of the coils used in the tank to heat the tar, so that we used about one unit instead of four units. That was with 110 pounds of steam. Recently, having occasion to cut down the pressure to 60 or 65 pounds of steam, we found that we had to put two units in service. In other words, with 110 pounds steam pressure on the heating coils in the tanks, one unit would do the work which has to be done with two units with 65 pounds steam pressure. The deduction from

this is that the emulsion of tar and water has to be heated as high as possible within the range of steam temperature, and we find then that we can run the water and the tar off separately from different draw valves, without waiting for it to cool. We have in the bottom of each of the settling tanks a steam coil made of 1 inch pipe. This has relatively quite a large surface, and the emulsion is pumped in in the forenoon and then the steam is turned on; the next morning, at the end of 24 hours, the steam is shut off, and then the separated tar and water are run out; then additional emulsion is pumped in. We get the tar and the water entirely separate. We don't seem to have to take much care as to how the emulsion is pumped in or the tar and water are run out, but we do want to get it as hot as possible by the use of the steam heat.

The President — I think it is only fair to say that, in starting this method originally, of the steam coil in the bottom of the tank, it was suggested—I think I am right, Mr. McKay—by Mr. Samuel Cabot, who purchases our tar.

Mr. Prichard — I was going to inquire if Mr. McKay had made any test of the temperature. He speaks of its being as high as possible. But if you raise it to 150° isn't it high enough to take the water out completely?

Mr. McKay — I don't think it is. I think it should be brought to a very slow boil; that is 200° to 212°. We find that we actually drive some of the water out of the tank in the vent in the form of steam, or it goes out as a vapor.

The Secretary — I would like to ask Mr. McKay if he gets any naphthaline along with his steam out of his tanks?

Mr. McKay — Naphthaline is driven off. When the steam is on the coils the tanks are vented into a scrubber, in the regular series of the gas apparatus, and the vents are large in area, 3 inches from the tanks that I speak of. Our settling tanks have quite a large capacity, and they all have 3-inch vents into this gas chamber, and the naphthaline that may be driven off goes into the gas. I hope enriches it. It never appears anywhere else. We know it does go off as naphthaline.

Mr. A. B. Slater, Jr. — I would like to ask the gentleman if, eliminating the water from his tar, the tar upon cooling stratifies into layers of different specific gravity, and, if not, about what the specific gravity of the clear tar is.

Mr. McKay — When the gas was not well fixed, with the

older form of apparatus, we used to find the strata that would be anticipated. There would be some lighter oils above the water and some layers of water and then tar. But with the Lowe apparatus we have a uniform tar. I would like to say that the emulsion as pumped into the tank is a concentrated solution, which we gain by use of the system that was suggested, or first operated, by Mr. Slater in Providence. We made very prompt use of that suggestion, and worked out the system so that it has been operated with perfect satisfaction for a great many years. The tar that is now obtained is apparently perfectly homogeneous, alike in all its strata. They do occur, but they appear to be very nearly one thing. It is a little difficult to say just what the weight of tar is. From the very heavy oils it is in the neighborhood of 9 pounds to the gallon.

The President—Mr. Slater, it would be interesting to know if you have your process still in use.

Mr. A. B. Slater, Jr. — The gentleman does me quite an honor in his remarks, but we are not now operating on the plan that we were some time ago, because we found that with a greatly increased rate of production we were distilling our tar in the hydraulic seal and the heat would be such that we had to change off; that we did not have sufficient means of cooling the drip on its way from the apparatus to the yard tank. In regard to the stratification of the oil tar, we do have some of that which we did not formerly have, and it appears to be the result of our inability to gasify satisfactorily the gas oil which we now have.

The President — I think if Mr. Slater will investigate the matter further and look backward a little he will find it does not require very large areas to operate this, or very large tanks. I refer now to the circulation in water from the hydraulic mains, getting a concentrated solution or emulsion, as Mr. McKay has called it. If he has had any trouble in that way I have no doubt that Mr. McKay would be glad to swap off some of the information he has in consideration of the information Mr. Slater has already furnished him in open meeting.

Mr. A. B. Slater, Jr. — I might say that at the time we first started to pump our tar over, pumping back to the hydraulic seal, our production of gas from the generating apparatus was very much less than we put out from the same apparatus now, and at that time the drip was successfully handled.

The President — Did you not find a little trouble with the air chamber on your pump at the time. Didn't you have a copper or brass air chamber, and didn't you find that that was eaten up by the tar?

Mr. A. B. Slater, Jr.— No, sir. We had a duplex pump without any air chamber at all.

The President — I warn any one who wants to use this method that it will be necessary probably to have cast iron, if they use any air chamber at all.

Mr. W. A. Wood — Mr. Allen requested me to bring in this sample here. It is a curiosity in its way; that is, it will be to the members who have never used oil fuel. To those of you who have it will not be a curiosity. The circulars sent out for instruction with all the fuel burners caution you against so adjusting the burner that a stream of oil and air or steam will strike hot firebrick. If it strikes hot firebrick the carbon begins to grow, and you have to break it off and readjust the burner so the oil goes into space and does not touch the hot firebrick anywhere. That piece was allowed to grow to see how far it would grow. It was in the firebox of an ordinary bench of sixes, which was about 4 feet long; I think the grate-bars were 4 feet 4. The style of burner shown here was being used with air blast. This (indicating) is a fire clay block here, which protects the metal part of the burner, while the distance from the front edge of this burner to the back of the firebox was about 4 feet. I allowed that to grow from that point, which represent the back—this is only half of the specimen—and it grew out until it attached itself to the front of the burner. You can see the action of the blast here. It found a vent, and near the burner the carbon formed a complete circle round the orifice. It is rather peculiar, and I am in a little doubt whether it is carbon or coke. I am sorry Mr. Hirt is not here; perhaps he could tell us. I should say myself that it was carbon. It has a good ring to it. But the growth of the thing was something instructive and rather astonishing. I think it took about 4 days to form that piece across the whole length of the furnace.

Mr. Sherman — We removed the water from our oil gas tar essentially in the way described by Mr. McKay. We have no success in attempting to burn water. I would like to call the attention of the Association to a matter that I brought up last year, which refers to the desirability of removing the carbon by

a jet of air. Another year's experience in that direction confirms the opinion I then expressed, that it was a very great improvement over any other method. We had been using for years previous to that Mr. Edge's process, which consists in introducing air into the retorts with a jet of steam; but as water in retorts is not a desirable element we found we could do a great deal better work by the introduction of air without any water. The carbon is removed very much quicker and with less injury to the retorts. Last year I told the members that we were using a Westinghouse air pump. At the present time we have one of Root's blowers, small size, which gives very excellent results.

The President — May I ask Mr. Sherman what pressure in the Root blower?

Mr. Sherman — Four inches, mercury pressure.

Mr. McKay — I would like to express my appreciation of Mr. Allen's work, and of the careful preparation of his paper, the illustrations or cuts especially assisting one in understanding and comprehending it. I move a vote of thanks to Mr. Allen. (Seconded.)

The President — It is moved and seconded that a vote of thanks be given to Mr. Allen, not only for the completeness of his paper but also for the trouble he has taken to get up the cuts so that the matter may be studied when read in the proceedings. (Adopted.) Mr. Allen, will you accept the vote of thanks of the Association for your kindness? We have some questions left in the question box.

The Secretary will read them.

The Secretary — The first question is:

"Would a gas inspector be justified in passing a job that had been made tight by healing up a leak by cold water application?"

Mr. Goulding — Mr. President, as I was the propounder of this question, if you think best I would like to make a statement of that which led me to it.

The President — Certainly, Mr. Goulding. We shall be glad to hear from you.

Mr. Goulding — A local gasfitter in my town put in two risers in a block. These risers were to supply gas to 15 meters located in five different parts of the building. The fitter

neglected to test these risers until the building was completed and the tenants moved in and called for gas. I refused to allow him to connect the risers with the Company's pipes until they were tested. They were then tested and found faulty. There being no way to get at them, unless they took off the lath and plaster, the fitter conceived the idea, which was certainly a novelty to me, of filling these risers, going up three stories in one-half of the building, full of cold water at a pressure of about 65 pounds. They stood about three days, the water was drawn off, were re-tested and found tight. It had always been my custom in the past, when a job was tested and found tight, to assume the responsibility for any leaks and turn the gas on. In this case I refused to do so, and my Manager wrote to the fitter and to the owner of the building to the effect that we would assume no responsibility in the future, and we turned the gas on under protest. This may seem a simple question, but it does not seem so to me. In a large block, or wooden building, the shrinkage, say, in a two story and a half building, if I am correct in my premises, in about 18 months, is $2\frac{7}{8}$ inches.

Mr. Macmunn—I have had some experience in that way myself, as to testing gas pipes by water. It should be condemned. I might relate an instance that came under my observation some 4 or 5 years ago in the City Hall, Marlboro, Mass. It was being repiped by a local fitter who notified me to inspect the work. On going there I found 110 pounds water pressure, a connection being made with the city water mains. I condemned it, ordering the fitter to draw the water off and put the air pressure on and also the mercury gauge, He did not find any indication of leakage by the water pressure but did on the application of the air, and very seriously. It took something like a week to make the necessary corrections in order to make a perfectly tight system. I asked him what his reason was for using water. He said that was the way he had done in another town for a number of years. I condemned the principle, and I believe that I will be sustained by this Association in condemning any such test.

Mr. Coffin — We do about 90 per cent. of the fitting done in our city, so of course we avoid a good many of these other things; but anywhere that we do not do the fitting we don't make any charge for inspection or testing. If it comes to a

time that the building is furred and ready to lath and plaster, and we have not been notified to go there and inspect the job, knowing that it has been done by other parties, we send the architect and the owner of the building a notice to the effect that, even though we are willing to inspect that job and test it without cost to him, it has not been done, and that unless it is done the probability will be that when we go there to set meters, if it does not pass inspection at that time, we shall refuse to turn on the gas. And it has had a very good effect. We don't have to send many of those notices now; not more than one a year, I think, in the last 4 or 5 years.

The President — Has any other gentlemen anything to say on this matter? The Chair will suggest to the gentleman who asked the question that he should get the opinion of the Chief Inspector of the City of Boston. They pass upon all such matters in Boston, and I don't think it is objectionable.

The Secretary — The next question is:

"Are wrought iron or steel tanks set on surface of ground considered better than brick and cement or stone and cement tanks set in the ground for gas-holders? Is there much difficulty in the construction of the latter so as to prevent leaking?"

The President — Is Mr. Mayer in the room? Is Mr. Carpenter here? If no one cares to give an opinion on this matter we will have to pass to the next question. A question from the question box has just been read. Will you hear it please? We think you might be interested in it. (This question was again read.) If Mr. Corbett does not wish to say anything—

Mr. Corbett — I shall leave that with the gas engineers, not with the contractors.

The President — Gentlemen, it is answered thoroughly, apparently. We are very much obliged to you for coming in, Mr. Corbett. Sorry to trouble you.

The Secretary — The next question is:

"At what price per net ton must anthracite be delivered, to compare with gas at $1 per 1,000 cubic feet for cooking?"

Mr. Richardson — I wrote that question hoping that an

answer may be made, as so many ask the question at home, "How does the price per ton compare with gas if sold at $1 per 1,000 cubic feet?" I hope if any one has made a careful computation he will give it.

Mr. Ramsdell — I think this is a very difficult thing to get at closely, but probably in a rough way those of us who have ranges in our houses and use anthracite coal know that it takes pretty close to a ton a month to run that coal range. You can compare in that way, it seems to me, in a rough way. I know I could run a gas stove for less money than I could anthracite coal at $5 a ton.

The President — What price of gas?

Mr. Ramsdell — $1.50 per 1,000.

Mr. Sherman — In the matter of heat units per ton of coal and in 1,000 feet of coal gas, the gas would have to be sold at 16 cents per 1,000 to compete with coal at $5.50 a ton, and water gas would have to be sold for 8 cents per 1,000 to compete with coal at $5.50 a ton. That was demonstrated practically by Mr. Dunning, of the Auburn (N. Y.) Gas Company, who heated his house with gas.

Mr. Coffin — We made some quite extended experiments on cook stoves only, without the bathroom attachment, and found that 2,000 feet of gas upon the average would run a family a month. Of course what that might cost and what coal might cost would be entirely a question for each one to settle himself locally. We found that with 2,000 feet of gas we could run an average kitchen cook stove, do the cooking by gas, but not for heating the room. We have, I guess, a dozen ranges set where they do their cooking all the year round with gas, and have either a register or radiator from their heating apparatus to heat the kitchen, so that they don't use this stove for heating purposes. In my own house, with a separate meter, with gas at $1.50, as it was four or five years ago, it cost us about $3.50 a month. We went a little over the 2,000 feet.

Mr. Ramsdell — I thought the idea was cooking stove consumption only, just as Mr. Coffin has put it. The figures I had in my own head were about 2,000 feet per month. I think the average stoves will show about in that ratio. Of course there are great abuses, and the servant girl problem is just as intricate in the gas stove end of the house as in other departments, but with ordinarily careful management, I think that would hold perfectly good.

Mr. Woodward—There seems to be a good deal of difference of opinion among the members on this matter. With the question, as Mr. Ramsdell states, of about 2,000 feet a month, I take it he does not mean that would be the amount for the gas range used exclusively. As most of you I think will agree with me, the gas stove is largely used as supplementary to the coal stove. People use the coal stove for wash-days, and perhaps two or three times besides a week, using the gas stove between. If they use the gas stove all the time, year round or even through the summer, they will hardly get along with 2,000 feet a month in the average house. With our customers, and I have figured over very carefully several different times, taking a customer one year that had no gas stove, and the following year when he had a gas stove, we find a fair average in consumption on the gas stove to run about 2,000 feet, as he says; but, at the same time, that was used as purely supplementary to the coal stove. A gentleman who tried this experiment of heating houses with gas in New York, taking the price there at $1 per 1,000, told me he put in his house a gas furnace of late, improved design, to find out exactly what the difference was between the cost of coal and gas to heat his house. He heated the house through two winters with the gas furnace (I judge the work was carried on under the most favorable conditions), and he found that it cost him just twice as much to heat his house with gas as it did with coal. He was anxious to make the showing better, but that was just what it did show. But, outside of any saving in the cost of material, you will acknowledge that, by using gas, he saved a great deal in labor, and also got rid of a deal of dirt and annoyance.

The President—I don't want to restrict the answer to this question, but I want to call the attention of the members, as it is now 1 o'clock, to the fact that the question was on cooking and not on heating.

Mr. Coggeshall—We have some 25 customers, using gas only for cooking, who have no other ranges. The average is about $5 a month with gas at $1.60 per 1,000.

Mr. Coffin—With bathroom attachment?

Mr. Coggeshall—Some of them have. I took the average of 25.

The President—Mostly, gentlemen, with one or two exceptions, have been talking about what their customers are doing.

I won't ask them whether they are using gas for cooking, but I will say that I used gas exclusively for cooking for some three years, with no method of heating the kitchen, which was a comparatively small one, except by the heat from the boiler, which was supplied with an independent water back, also heated by gas, and I found that it cost less money to do all the cooking, heat all the water and keep the kitchen warm (by having the water in the boiler heated on very cold nights), than it did with the coal before. That is actual experience.

A Member—How much per 1,000 feet?

The President—At $1 per 1,000. Coal is from $5 to $6 a ton, I think, in Boston.

Mr. Coffin—That answers the question.

Mr. A. B. Slater, Jr.—The conditions at my home are very similar to those at your home, as you describe them. I have used gas for several years now, and have no coal stove. I find I use about 6,000 feet of gas where I formerly used 1½ tons of anthracite.

The President—That is a very clear answer, I think, to your question, Mr. Richardson. I will add that my bills, I think, were between $75 and $85 a year for gas, which includes illumination. We will pass to the next question.

The Secretary:

"At what price can gas be produced by any of the acetylene gas machines?"

The President—One question leads to another very naturally. No carbide or acetylene experts in the room?

Mr. Richardson—If I may rise without being counted, I would say that is a hard question to answer directly as it is asked, but it is a very easy matter to compare what gas will do with the Welsbach burner with acetylene advocates' claim of 25 candles for every half foot of acetylene. The carbide, as it comes of course, is as the run of the furnace, and it is claimed to yield 10,000 feet to the ton; but I guess the run of the furnace would not give it. However, one-half foot of acetylene gas yields 25 candles and three feet of ordinary gas in a Welsbach burner yields 50 candles. It is a mere matter of computation of one to three. And if 10,000 cubic feet of gas be obtained from the ton of carbide, at a cost of $75 per ton, that is $7.50 per 1,000 for the acetylene gas. So ordinary gas sold

at $2.50 with the Welsbach burner would be cheaper in every respect than acetylene gas at $7.50.

The President—Mr. Richardson, we thank you for that comprehensive reply.

The Secretary — The next question is:

" In case of two lift holder housed, why not dispense with guide rolls on top of lower lift ? "

Mr. A. B. Slater, Jr.—In response to that I would say I am now putting in a two-lift holder. The holder is about 70 feet in diameter and the lifts are about 29 feet. We have dispensed with the guide rolls on the outside of the lower lift. I don't see any use for them there.

The President—Have gentlemen any experience in this direction? Certainly, in an enclosed holder there is no wind pressure to take care of, which is, of course, one of the principal elements.

Mr. Prichard—Mr. President, to go back a moment, I feel perhaps we have slighted one question that was asked, and perhaps the gentleman may not have been in as good position to get information as we are here. I know there are something like 140 odd gentlemen who could answer this question better than I can, but I thought a few words might not be out of place. That was on the question of steel tank holders. Perhaps we all agree that a brick and cement tank in the ground, if well built, is practically indestructible; that the lifetime of a steel tank built on the ground has not been determined yet by experience, but a steel tank is a very good thing. It is an extremely difficult thing to build a brick and cement or stone tank in the ground, if the foundation is not of the very best; but it is not at all difficult to build a steel tank. One can throw the risk on the contractor by building a steel tank, but one cannot very well do it on a concrete tank, and that, at present prices of iron, the expense in either case is about the same. Perhaps that will start the gentleman on the line on which he wants to get.

The President called for the regular order, in response to which the following reports were submitted:

REPORTS IN MEMORIAM.

MR. WILLIAM W. GREENOUGH.

"Mr. William W. Greenough, the first President of the New England Association of Gas Engineers, died in Boston, June 17th, 1899.

"Mr. Greenough was for many years the Treasurer and General Manager of the Boston Gas Light Company, which corporation prospered exceedingly under his careful and judicious management.

"He was a gentleman of extensive education and superior ability, qualities which made him prominent in all gas circles of the country and placed his name at the head of the list of gas engineers in New England. He also had a large acquaintance with the foremost gas engineers of his day in Europe.

"Mr. Greenough was always ready to meet other gas engineers for consultation or advice, and his office in West street was a headquarters for the gas men of Massachusetts. In fact, the early meetings of this Association were held in his office.

"In the death of this, our first President, every member of the Association lost a sincere friend.

"CHARLES DUDLEY LAMSON,
"CHARLES H. NETTLETON, } Committee."
"HORACE A. ALLYN,

MR. LYMAN P. GEROULD.

"Mr. Lyman P. Gerould, one of the original members of this Association, died at Northampton, Mass., November 27th, 1899. Mr. Gerould was for many years connected with the Newton and Watertown (Mass.) Gas Company, the Manchester (N. H.) Gas Company, and the Nantucket (Mass.) Gas Company, as Engineer and Superintendent, and was regarded as a successful manager. Owing to ill health he relinquished some years ago active interest in the business. He served a term as Vice-President of this Association, and was instrumental in forming the Guild of Gas Managers.

"The members of this and other Associations regret his departure, and will long cherish his memory.

"A. B. SLATER, JR.,
"F. C. SHERMAN, } Committee."
"HENRY B. LEACH,

The reports were received and ordered filed.

MR. GUSTAVUS E. WETHERBEE.

TO THE MEMBERS OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS:

Gustavus E. Wetherbee, a member of the New England Association of Gas Engineers, died at his home in Roxbury, Mass., June 10, 1899.

Mr. Wetherbee had been engaged in the gas business for over 30 years, having been connected successively with the following gas companies: Newton and Watertown, Mass., from 1860 to 1862, when he enlisted with the 44th Massachusetts Volunteers; Boston Company, from 1868 to 1875; Jamaica Plain, 1875 to 1878; Roxbury, 1878 to 1884; Boston Company (Commercial Point works), 1884 to 1887; Worcester (Mass.) Company, 1887 to 1897. He was Superintendent of the latter company for 10 years, when, after a season of continued ill health, he was obliged to give up his position and go South. In February, 1898, he again became connected with the Roxbury Company, taking direct charge of the distribution systems of the Roxbury and Brookline Companies in the Roxbury district. He may truly be said to have died in harness, as he was in his office until 10 o'clock of the forenoon of the day he died.

Mr. Wetherbee was married in November, 1874, to Miss Louisa B. Balcom, of Eastport, Me., who with two daughters survives him.

He was highly esteemed by all who knew him, and in his death the Association loses a kind, generous and true hearted member.

J. A. GOULD,
CHAS. F. SPAULDING, *Committee.*
WILLIAM ANDERSON,

VOTES OF THANKS.

The President—Our hour for adjournment has arrived. I want to take this occasion, gentlemen, to express my thanks to the Secretary for the way he has arranged this meeting. The President has not done a thing in that direction, and you can see that nothing appears to have been omitted in the proceedings. I want to say this is due to your Secretary. I also want to thank the members for the assistance they have given

There weren't so very many who replied to our letters, but the results of the meeting, as they stand, are due to those who have given hints as to what they would like. It is a very nice thing in ordering your dinner to know that the meal will suit the palates of those who are to partake of it, and I hope next year we will get a great many suggestions. Gentlemen, we are now facing another year. Perhaps in the case of some of us it may be a year of strife, but I think if we approach the matter with "Malice towards none and charity towards all," and that if with our corporations we are "Always faithful," then if we do not possibly win in all things, we can at least have "Peace with honor."

On motion of Mr. Sherman the thanks of the Association (tendered officially by the Secretary) were voted to President Addicks for the very able and courteous manner in which he presided over the deliberations of the session. The Secretary in reporting the vote left it to the sense of discrimination of the Association as to how much of the President's recent remarks it was best for them to believe. The President thanked the members for their recognition of his efforts to direct the proceedings.

Mr. Sherman also moved that the thanks of the Association be tendered to the Secretary for the very able manner in which he performed his part. He said it was only those who were in his position knew the labor and anxiety attendant upon the office, and that it certainly was a labor of love in every case, for every Secretary they ever had did his work out of love for the profession and the Association.

The motion having been seconded and adopted, the President said: Mr. Secretary, I have had the pleasure of being secretary of societies—not gas societies—and know how much work attaches to such positions, therefore I am very glad indeed to notify you of this vote.

On motion of Mr. Coffin, (seconded by Mr. Neal) the meeting was declared adjourned.

PROCEEDINGS

OF

THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS

THIRTY-FIRST ANNUAL MEETING,
FEB. 19 AND 20, 1901.

First Day, Feb. 19 — Morning Session.

The 31st annual meeting of the New England Association of Gas Engineers was convened promptly, at the place and date above named, through the announcement of the President, Mr. Walter R. Addicks, of Boston. The Secretary (Mr. Nathaniel W. Gifford of New Bedford, Mass.) announced the regular order. On motion of Mr. Coggeshall the reading of the minutes of the last meeting was dispensed with.

REPORT OF THE BOARD OF DIRECTORS.

The Secretary then read the following report from the Board of Directors:

TO THE MEMBERS OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS:

Your Directors report as follows: That they have approved the applications of the following for

ACTIVE MEMBERSHIP,

subject to the payment of dues:

Erhard, T., Ass't Supt., Cambridge (Mass.) Gas Light Co.; Gillette, S. E, Engineer, Marblehead and Danvers (Mass.) Gas Companies; Hawkens, T., Mgr. Knox Gas and Electric Co., Rockland, Maine; Lawson, W. H., Peoples' Gas Light Co. Rutland, Vermont; Leonard, C. F., Ass't Supt. Fall River (Mass.) Gas Works Co.; Miles, C. H. Mgr. Lexington (Mass.) Gas and Electric Co.; Morse, C. W., President and General

Manager, Amesbury and Salisbury (Mass.) Gas Light Co.; Macomber, G. E., President Knox Gas and Electric Co. Rockland, Maine; Ruggles, C. S. J., Supt., Gardner (Mass.) Gas, Fuel and Light Co.; Spear, J. N., Supt. South Boston (Mass.) Gas Light Co.; Stone, A. F., Supt., Chelsea, (Mass.) Gas. Light Co.; Thompson, C. F., Treas. and Mgr. Gas Light Co., Brattleboro, Vermont.

They also recommend the election of the following to

ASSOCIATE MEMBERSHIP.

Austin, C., Treas. and Mgr., Citizens Gas Light Co., Quincy, Mass.; Baker, S. E., Chief Clerk, Fall River (Mass.) Gas Works Co.; Brown, G. P., Mgr., Fall River (Mass.) Gas Works Co.; Baldwin, C. H., Mgr. National Meter Co., Boston, Mass.; Chandler, F. E., President Malden and Melrose (Mass.) Gas Light Co.; Cheney, C. S., Gen. Mgr. Gas Works, Cheney Bros., South Manchester, Conn.; Davidson, R. A., Brookline Gas Light Co., Allston, Mass.; Finn, G. H., Gen. Mgr., New England Gas and Coke Co., Boston, Mass.; Farrington, A. N., Boston (Mass.) Gas Light Co.; Gardner, W. H., Jr., Boston, Mass.; Greims, O. F., Supt., New England Gas and Coke Co., Everett, Mass.; Hill, W. H., President, Citizens Gas Light Co., Quincy, Mass.; Hamlin, H. R., Boston (Mass.) Gas Light Co.: Humphreys, F. H., New Haven (Conn.) Gas Light Co.; Heustis, F. C., Cambridge (Mass.) Gas Light Co.; Montgomery, J. K., President, Chelsea (Mass.) Gas Light Co.; Nichols, W. B., Roxbury (Mass.) Gas Light Co.; Plunkett, W. R., Treasurer, Pittsfield (Mass.) Coal Gas Co.; Wilder, C. C., Newton, Mass.

They also recommend the

TRANSFER FROM ASSOCIATE TO ACTIVE MEMBERSHIP

of Mr. Wm. L. Walker, Supt., Fitchburg (Mass.) Gas and Electric Light Co.

They further report the resignations of Mr. N. C. Dye and Mr. William Holmes.

Respectfully submitted,

N. W. GIFFORD, Sec'y.

On motion of Mr. Neal the report was accepted.

ELECTION OF NEW MEMBERS.

On motion of Mr. Nettleton the Secretary was directed to cast the ballot of the Association in favor of the election to membership of the gentlemen named in the report of the Directors. The Secretary having reported that the instruction had been carried out, the President announced the result and welcomed those present of the newly elected to the convention and its proceedings, in which he hoped they would take positive part. The President further appointed Messrs. Geo. B. Neal, W. E. McKay, H. A. Norton, John A. Coffin and Wm. A. Anderson a committee to introduce the new members to the old ones.

The calling of the roll having been postponed, President Addicks read the following

INAUGURAL ADDRESS.

GENTLEMEN OF THE NEW ENGLAND ASSOCIATION: Still another year is added to our existence as a Gas Association, this being our 31st annual meeting. This, the first year of the 20th century, finds us not lacking in those elements that go to make up a still stronger Association. You will see by the names submitted to you for membership that interest in your profession does not seem to be languishing; it is right that it should not, and I repeat the assurance of last year that the future of the gas engineer is most promising.

The past year has produced the greatest union of gas and electricity that the century has yet seen. I need hardly say that it seems a wise step and may well be imitated elsewhere, as it is in the interest of the public from every point of view. My musing of last year was not devoid of practical elements, for I believe that our profession will one day make the gas and electricity for our communities for purposes of light, heat and power in every form, and on a scale now hardly dreamed of.

Public agitation with attack does not seem to be quite so active except in some storm centers, and one may at least look forward to the end, even in these places, if only with that degree of hope measured by the lapse of time seemingly necessary for its accomplishment.

We have repeated the policy of last year in having, in addition to our regular papers, addresses on retorts, horizontal

and inclined, as well as coke ovens, all up to date. Every effort has been made to have the members state what subjects were interesting them particularly this year, and an endeavor was made to satisfy the want. I trust that the results will not be disappointing. The range of the paper list is quite wide and we must devote ourselves closely to business that we may get through our programme without slighting any subject. I desire to state that I will call the sessions to order at the specified times, and I especially request all members to be in the meeting room in seasonable time. I will not attempt to review in detail the papers presented, but make my observations as short as possible, giving room for more profitable matter.

Mr. Fowler called my attention to the Self-Intensifying Gas Lamp, two of which I have ordered from abroad for test. I regret that they have not been received for exhibition at this meeting. Quite a large range of experiments have been made by our Dr. Wing under my direction, showing the efficiency of the Welsbach mantles when used in connection with different types of burners, and at pressures ranging from normal ruling pressures up to 12 and more inches water pressure. As this subject has not yet been treated as thoroughly as it deserves, I have not ventured to present it to you this year, but I wish to say that the results obtained are most encouraging. I desire to direct your attention to the articles appearing in the gas journals on this subject. The following figures bearing on this subject were furnished me a couple of weeks ago by an English concern:

Gas used 16-Candle Power London Gas.

Water Pressure.	Gas Consumption.	Candle Power.	Candle Power Efficiency.
8	11	350	31.81
9	12	375	31.25
10	12.5	400	32
11	13	440	33.84
12	13.5	440	32.59
13	14.5	510	37.17

It is by no means impossible that the problem of piping the modern high building for gas may be solved by using a high pressure system with incandescent mantles in burners consuming from $\frac{1}{2}$ cubic feet to 10 and 15 cubic feet of gas per hour.

For obtaining high pressures I am searching for the motive power and method of governing these high pressures with absolute regulation. Mr. Fowler I know is working in the same direction. It is evident that these high pressures will allow us to reduce the size tubing in use in tall buildings, even if the high pressure is only used during business hours. Such tubing would readily supply the needs at night at present ruling pressures, and some of the lights may be adjusted for this pressure or, by means of a 2 way cock, may be used on either pressure, high or low. I am preparing such a system in our West street office in Boston. Our present scales make piping for large and tall buildings a severe tax on the practical man's judgment; with high pressure the areas might be reduced at least one-half and possibly more.

Prepayment meters, gas stoves, gas ranges and similar devices, still retain their popularity as a means of satisfying the public and increasing our business.

Advertising in the right place, at the right time and with a careful regard to the expense account will undoubtedly be found advantageous.

I particularly wish to call your attention to the gas engine and its future. An opportunity was afforded to test a 20-horse power gas engine on electric light service. I endeavored to persuade some prominent members of this Association to test this engine, but was unsuccessful. I therefore appointed a Board composed of gentlemen connected with our Boston Companies, and requested Mr. G. E. Whitney, who has charge of our drafting room, and who is a member of the Boston Society of Civil Engineers, to act as its chairman. Mr. Whitney is responsible for the manner in which the Board carried out this test, and one of its members, Mr. H. N. Cheney, will give you a paper on the subject. A careful study of the data will disclose its usefulness for future reference.

Without doubt with the gas engine we can obtain at least 30 kilowatts per 1,000 cubic feet of gas, and with this gas at \$1.00 per 1,000, we obtain 1 kilowatt (which is equivalent to 20 50 Watt lamps 1 hour) for 3.3 cents. When you consider that by the use of the Wright discount meter, the electric light companies pride themselves in offering each kilowatt beyond a guaranteed quantity (which quantity is paid for at 18 cents kilowatt) at the low price of 8 cents per kilowatt, it should

start you to thinking, particularly when you know that you can get today absolutely perfect electric regulation, even when going instantaneously from full load to ¼ load and *vice versa*. The figures I gave in my last annual address were those furnished by manufacturers, but we can now have exact facts and results of careful tests. Many of you will be able to supplement these figures with equally accurate information. Your particular attention is directed to the good efficiency at ¾ load when compared with full power, and this I consider of great importance. Your attention is directed to the advisability of running power direct while you obtain your electricity from your dynamo on the same shaft, thus avoiding loss in transmission through the dynamo and back through the motor. My personal preference is for a vertical engine, but large bearings should be an essential feature and quick accessibility for clearing the valves is of paramount importance. I am about installing a plant in our gas office at West street, for elevator and other service. I hope there will be full discussion on this subject.

We will be particularly interested in what Messrs. Shelton and Allen have to say about "Gas Lighting at the Paris Exposition" and "How they do Things on the Other Side." It will be remembered that Mr. Allen represented the New England Association at the Paris Congress.

Our good friend "Purification" will be ably handled by Messrs. Fowler, of Springfield, and Miller, of Newark. A glance at the State Inspector's report for this year will convince one that we can still learn something more about purification. Your close attention is directed to this subject. If the coke oven system is to be still further extended, purification will prove of primary importance.

We welcome again to our paper list a name so prominently identified with our Gas Associations and gas industry, Mr. C. J. R. Humphreys, who will give us a practical business paper, and his namesake from Worcester will call your attention to the fact that there is more than one or even a dozen ways to govern your gas system successfully. Dr. Schniewind has kindly offered to give us some fresh matter on coke ovens, and we hope to hear from Mr. Egner on inclined retorts, and from Mr. Ramsdell on horizontals and machinery, and from Mr. Prichard, on both inclines and horizontals.

The great oil well "gushers" we read of almost daily are not without interest to the profession generally.

I wish to direct your attention to the desirability of having your proceedings printed from the beginning of your Association's history to the present time. I have investigated the matter and you will find on the table the proceedings of the 30th annual meeting in pamphlet form, obtained by cutting from the files of the American Gas Light Journal. It will surprise you as it surprised me, how apparently readily the Gas Light Journal could print your proceedings in pamphlet form from the same type they print their Journal copy, and thus insure a year book within 30 days of the holding of the annual meeting. Investigation in New York, however, convinced me that what seemed simple, proved to be hardly practicable, but the American Gas Light Journal with their usual courtesy, offered to give the Association the use of the electrotypes they possess, as well as their files, should the Association desire to publish their proceedings in book form. They also suggested that I take up the subject with some printing office using a linotype machine. I have done so and Exhibit "A" is a letter I have received on the subject. The Secretary can perhaps obtain better figures. It is understood that the linotype work is to be done from the printed editions of the American Gas Light Journal as a proof and not from manuscript. Mr. W. A. Wood when President, suggested publishing the proceedings, and he appointed, by authority of the Association, a committee to consider the subject. The committee never reported, and history fails to identify their individuality even. Mr. Wood's recommendations are hereby renewed.

We look forward with interest to the report of the Standing Committee on Electrolysis. Those who read the English gas journals will see that London is being stirred up with this question.

A member of the Board of Directors (Captain McKay) called my attention to the fact that the members for many years have not subscribed their names to the by laws, and that it is a matter of interest as a record to have all signatures of our members. I agree with him, and I am going to ask the Secretary to read the names of all members who have signed the roll. Those present I hope will do so during the session.

Death has laid a heavy hand on our Association this year,

and was not content to take those who had passed their appointed span of life amongst us, but has taken from our midst also younger members on the threshold of a great career. You will approve, I know, my appointment of committees to report to the Association appropriate resolutions. The names of those who have passed away since our last meeting are as follows:

ACTIVE MEMBERS.

Hon. J. M. Hill, of Concord, N. H., March 4, 1900.
Mr. Henry A. Atwood, of Plymouth, Mass., March 17, 1900.
Mr. G. T. Thompson, of Denver, Col., October 1, 1900.

ASSOCIATE MEMBERS.

Mr. Robert R. Smith, of New Haven, Conn., May 12, 1900.
Mr. Fritz H. Twitchell, of Bath, Me., February 4, 1901.

You will undoubtedly approve, also, of the Secretary spreading these resolutions upon the minutes of the Association, furnishing the gas light journals with the resolutions and sending copies to the families of the deceased.

I would not be doing my duty, nor would I be satisfying a sincere feeling of gratitude, did I not refer to your Secretary and his work. If this meeting. for which we have a greater share of responsibility than any other members, meets with your approbation, I wish to say that his labors contribute in a larger measure to that end than my own. I congratulate the Association in being so well served in the office of Secretary, the most important for the success of the annual meetings. Anyone having served as the Secretary of any Association realizes the hours of labor to perform its duties.

Now, gentlemen, I leave this meeting in your hands. We have tried to serve you as you would be served, and you must make this meeting profitable one to another by your own united efforts.

COMMITTEE ON PRESIDENT'S ADDRESS.

On the conclusion of the reading of the address the message was referred for consideration and report to a committee consisting of Messrs. Chas. H. Nettleton, H. A. Allyn and F. H. Shelton.

APPOINTMENT OF COMMITTEES ON MEMORIALS.

The President appointed the following committees on memorials to deceased members, with the understanding, if the reports could not be prepared in time for presentation to the meeting, owing to difficulty in promptly securing the relative facts, that the narrations could be subsequently spread upon the minutes, copies of the same being sent to the American Gas Light Journal and to the families of the deceased:

Hon. John M. Hill, Concord, N. H.— Messrs. Geo. B. Neal and H. F. Coggeshall.

Mr. Henry A. Atwood, Plymouth, Mass.— Messrs. H. A. Allyn and W. A. Learned.

Mr. George T. Thompson, Denver, Col.— Messrs. Walton Clark and W. E. McKay.

Mr. Robert R. Smith, New Hartford, Conn.— Messrs. C. H. Nettleton and F. C. Sherman.

Mr. Fritz H. Twitchell, Bath, Me.— Messrs. Jno. A. Coffin and E. H. Yorke.

REPORT OF SECRETARY.

As Secretary, Mr. Gifford reported that, to date of February, 1901, there were on the rolls 179 members, classified as follows: Honorary, 9; active, 133; associate 37.

REPORT OF TREASURER.

As Treasurer, Mr. Gifford reported a receipt for the year of $896.50 an expenditure of $687.14, and a final balance of $1,059.43.

On motion the report was accepted.

READING THE CORRESPONDENCE.

The Secretary read several letters from members of the fraternity explaining why they could not attend the meeting, and wishing the Association further success along the line of the good work that it had instituted and was continuing.

DISPOSING OF THE HILL MEMENTO.

The President — Has the Secretary any further matter to bring to our attention?

The Secretary — Amongst the list of deceased members is the name of the Hon. John M. Hill, late of Concord, N. H.

Mr. Hill, who, as you know, was for many years a member of the Association, and had its interests very much at heart, in his will bequeathed to the Association this inkstand, which was presented to him by the Directors of the Concord Company on the completion of 33 years' service with the company. It is inscribed:

"Presented to John M. Hill of Concord Gas Light Company, January 1st, 1889, in token of recognition of 33 years' faithful service in the management of the affairs of the corporation."

On the death of Mr. Hill his son wrote me of the presentation. I asked him if he would keep the token until the time of the meeting and send it down. It is here for your inspection and action.

The President — Gentlemen, I should like to hear from you in regard to the disposition to be made of the gift.

Mr. Lamson — I move that the Association accept the gift with thanks, and that we officially convey our acceptance in an appropriate way.

Captain White — Mr. President, in seconding the motion I desire to say that, while the Association necessarily appreciates the intention of our deceased old member in presenting to us this token, which must have been a gracious one to him when received from his Directors, yet I feel that as the Association has no proper place in which to keep it where it could be seen by our members, and it being well known to the Directors of our Association that the family does esteem it highly as a relic, and an evidence of high appreciation in which the Concord Company held our friend associate, I, therefore, in seconding the motion to accept from his executors this inkstand, would move to amend the motion to say that we return, together with our thanks for it, this gift to the family. Feeling that as we have no proper place in which to protect it, and recognizing that, as a family relic, it would have great value to them, this Association desires that the family should retain this evidence of the appreciation by his Directors of a lifetime well spent in the service of his company. I presume the proposer will permit me, in seconding his motion, to add to it in that way. Accepting in becoming and fitting terms this gift, acknowledging that it has duly reached the Association, but, appreciating the fact that it is a family relic, and one which they

must necessarily value highly, the Association, with its compliments, return it to them as its best custodian.

Mr. Lamson accepted the suggestion conveyed in the seconding of Capt. White, and the President inquired as to the further sentiment of the Association in the premises.

Col. F. S. Benson — Would it not add to the value of the gift to the family if an amendment like this to Capt. White's suggestion prevailed. I move that an amendment thereto, providing that a suitable inscription in addition to the one now there be placed on the inkstand, showing that it was accepted by the Association and returned, as a mark of our esteem to the family.

The motion, as amended by Capt. White and Col. Benson, was adopted, and the Secretary was instructed to act in accordance therewith.

The President called for the

REPORT OF THE COMMITTEE ON ELECTROLYSIS.

Mr. Prichard, of the Committee, in responding to the call, said the Committee had no special report to make at the time. There had been no particular development over the matter in the interim.

At the suggestion of the President, in view of the fact that matters might develop in the current year, the Committee was continued.

APPOINTMENT OF COMMITTEE ON NOMINATIONS.

The President appointed as a Committee on Nominations, Messrs. C. F. Prichard, S. J. Fowler and F. C. Sherman.

ROLL CALL.

The following members responded to the roll call:

HONORARY.

Benson, Col. F. S.	Brooklyn, E. D., N. Y.
White, Capt. W. H.	New York City

ACTIVE.

Addicks, W. R.	Boston, Mass.
Alden, G. A.	Watertown, Mass.
Allen, B. J.	Allston, Mass.
Allyn, H. A.	East Cambridge, Mass.
Anderson, W.	East Boston, Mass.
Barnum, D. D.	Worcester, Mass.

Bartlett, L. . . . . Cottage City, Mass.
Clark, W. . . . . Philadelphia, Pa.
Coffin, J. A. . . . . Gloucester, Mass.
Coggeshall, H. F. . . . . Fitchburg, Mass.
Cook, R. W . . . . Providence, R. I.
Cowperthwaite, G. E. . . . . Danbury, Conn.
Crafts, H. C. . . . . Northampton, Mass.
Dickens, J. . . . . Newburyport, Mass.
Fowler, S. J. . . . . Springfield, Mass.
Frost, C. T. . . . . Plymouth, Mass.
Gifford, N. W. . . . . New Bedford, Mass.
Gould, J. A. . . . . Boston, Mass.
Goulding, N. O. . . . . Natick, Mass.
Hassett, E. J. . . . . Beverly, Mass.
Hintze, T. H. . . . . Lowell, Mass.
Hirt, L. J. . . . . Everett, Mass.
Humphreys, C. J. R. . . . . Lawrence, Mass.
Humphreys, J. J., Jr. . . . . Worcester, Mass.
Jenks, Z. M. . . . . Woonsocket, R. I.
Jennings, F. W. . . . . South Framingham, Mass.
Lamson, C. D. . . . . Worcester, Mass.
Lane, H. M. . . . . Leominster, Mass.
Leach, H. B. . . . . Taunton, Mass.
Learned, E. C. . . . . New Britain, Conn.
Learned, W. A. . . . . Newton, Mass.
Learned, C. A. . . . . Meriden, Conn.
Lucey, F. J. . . . . Natick, Mass.
Macmun, G. F. . . . . Marlboro, Mass.
Manchester, G. L. . . . . Easthampton, Mass.
Mansfield, G. W. . . . . Salem, Mass.
McKay, W. E. . . . . Boston, Mass.
Miller, C. Newark, N J.
Milne, J. D. . . . . Norkwalk, Conn.
Mooney, E. B. . . . . Brockton, Mass.
Morrison, H. K. . . . . Concord, N. H.
Moynahan, J. F. . . . . Stoneham, Mass.
Neal, G. B. . . . . Charlestown, Mass.
Nettleton, C. H. . . . . Derby, Conn.
Norton, H. A. . . . . Boston, Mass.
Norton, W. F. . . . . Nashua, N. H.
Norton, P. T. . . . . Nashua, N. H.
Nute, J. E. . . . . Fall River, Mass.
Nutting, C. H. . . . . Chicopee, Mass.
Parker, F. H. . . . . Burlington, Vt.
Prichard, C. F. . . . . Lynn, Mass.
Richardson, F. S. . . . . North Adams, Mass.
Rossman, G. M. . . . . Keene, N. H,
Sargent, F. H. . . . . Lawrence, Mass
Shelton, F. H. . . . . Philadelphia, Pa.
Sherman, F. C. . . . . New Haven, Conn.
Sherman, C. D. . . . . New Haven, Conn.
Slater, A. B., Jr. . . . . Providence, R. I.
Snow, W. H. . . . . Holyoke, Mass.
Spaulding, C. F. . . . . Waltham, Mass.
Spaulding, W. H. . . . . Westerly, R. I.
Stearns, W. M. . . . . Waltham, Mass.
Stratton, W. K. . . . . Haverhill, Mass.

Thayer, W. F.	Clinton, Mass.
Tilton, D. D.	Newburyport, Mass.
Todd, J. R.	Walnut Hill, Mass.
White, C. E.	Wakefield, Mass.
Wood, W. A.	Boston, Mass.
Woodward, R.	New Rochelle, N. Y.

ASSOCIATE.

Allen, W. S.	New Bedford, Mass.
Barnes, A. M.	Cambridge, Mass.
Browne, A. P.	Boston, Mass.
Cheney, H. N.	Boston, Mass.
Cortis, D. T.	Boston, Mass.
Davis, F. J.	Waltham, Mass.
Dunbar, A.	Brookline, Mass.
Fiske, J. T.	Concord, N. H.
Holmes, R. E.	Winsted, Conn.
Langwith, F. A.	New Haven, Conn.
Mace, F. W.	Lynn, Mass.
Macmun, G. F., Jr.	Pawtucket, R. I.
Norton, A. E.	Boston, Mass.
Scranton, G. H.	Derby, Conn.
Sprague, P. W.	Boston, Mass.
Thomas, F. W.	Boston, Mass.
Tufts, J. P.	Boston, Mass.
Waldo, C. S.	Boston, Mass.
Waldo, J. A.	Boston, Mass.
Wardwell, W. R.	Boston, Mass.
Walker, W. L.	Fitchburg, Mass.

The President announced that the next business in order was the reading of the papers, and introduced Mr. S. J. Fowler of Springfield, Mass., who read the following

Remarks on Gas Purification.

The city of Springfield is built in a half-circle, bounded on the west by a broad river which forms the cord of the arc. The gas works are situated almost in the middle of this diameter, and as they are very near the principal business streets of the city, it is consequently desirable that there shall be as little offensive odor from them as possible. Most of our trouble has come from purifying material which, whether lime or iron mass, had to be shovelled over or carted through the streets. At the same time purification cannot be neglected, for the laws of the State of Massachusett allow no sulphuretted hydrogen in gas as sent out, and but 20 grains per 100 cubic feet of total sulphur in other forms.

Up to October, 31, 1895, the purifiers had been run with lime exclusively. They were four in number, each 10 feet by

16 feet, and about 3 feet deep. On the above date these boxes were abandoned and others put into use 20 feet x 32 feet, and 3 feet, 6 inches deep, which were each filled with about 1,000 bushels of iron mass, containing 15 pounds of metallic cast iron borings to the bushel of sawdust. The comparative expense of purification, with lime in the old boxes and with iron mass in the new ones, is as follows: From July 1, 1890, to October 31, 1895, there were made 499,506,000 cubic feet of gas, and the expense for lime and labor was $9,972.77, or $19.96 per million cubic feet. From October 31, 1895, to July 1, 1900, there were made 653,184,000 cubic feet, and total expense was $2,050, or $3.14 per 1,000,000 feet, which is a difference of $16.82 per 1,000,000, or, on the total quantity of 653,184,000 cubic feet, a saving of $10,958. But as the first 5,000 bushels of oxide became loaded with sulphur, and as the annual make increased, it was necessary to change the boxes oftener, and sometimes the wind would carry the smell into the city. I, therefore, proposed to introduce air into the gas to help on purification. Before attempting to make any change I, of course, brought up the subject before the Guild of Gas Managers, and, after receiving the usual amount of contradictory information and advice, resolved to put in the necessary machinery. The plan shows what was evolved. A small pressure blower was belted to the counter-shaft running the exhauster, and the air was led through a seal pot and a wet meter to the spot in the machine room nearest the hydraulic main, where the temperature of the gas is about 120° F. We introduce from 1 to 1½ per cent. of air. The gas is not cooled thoroughly, as owing to local conditions, we do not save ammonia, and is passed through the scrubber and purifiers at about 80°. This apparatus was put in operation March 18, 1900, five days after we had made a change of purifiers. Since then, up to January 1, we have made 5 changes.

I propose to describe the contents of the boxes, give the reasons for changes, what we found, and how the boxes ran. The first box was charged with material containing 15 pounds of cast iron borings to the bushel of sawdust, which material had been used twice, and had purified about 16,500,000. This layer was a little over 2 feet deep. Below this was a layer, 4 inches deep, of sawdust, which had been used several times,

and which is intended to catch any tar. The second box was charged with like material, which had been used twice and had purified about 15,000,000. The bottom layer was the same as in number one. The third box was filled with new material, half shavings and half sawdust, with 15 pounds iron to the bushel. The lower layer was old and heavily charged iron mass. The fourth box was material which had been used and had purified about 12,000,000. The bottom layer was also old, and heavily charged oxide. The fifth box was the same as the third, except that the lower layer was fresh sawdust. I will here give a table of the changes and the quantity of gas made with the quantity of air used:

Started March 13.			Gas made Cu. Ft.	Air Used.
1st	change,	July 26,	51,725,000	350,050
2nd	"	Sept. 22,	23,185,000	255,580
3d	"	Nov. 27,	37,478,000	468,250
4th	"	Dec. 8,	6,311,000	64,770
5th	"	Dec. 21,	8,652,000	138,810
	Total		127,351,000	1,457,460

which is about 1.2 per cent of the total.

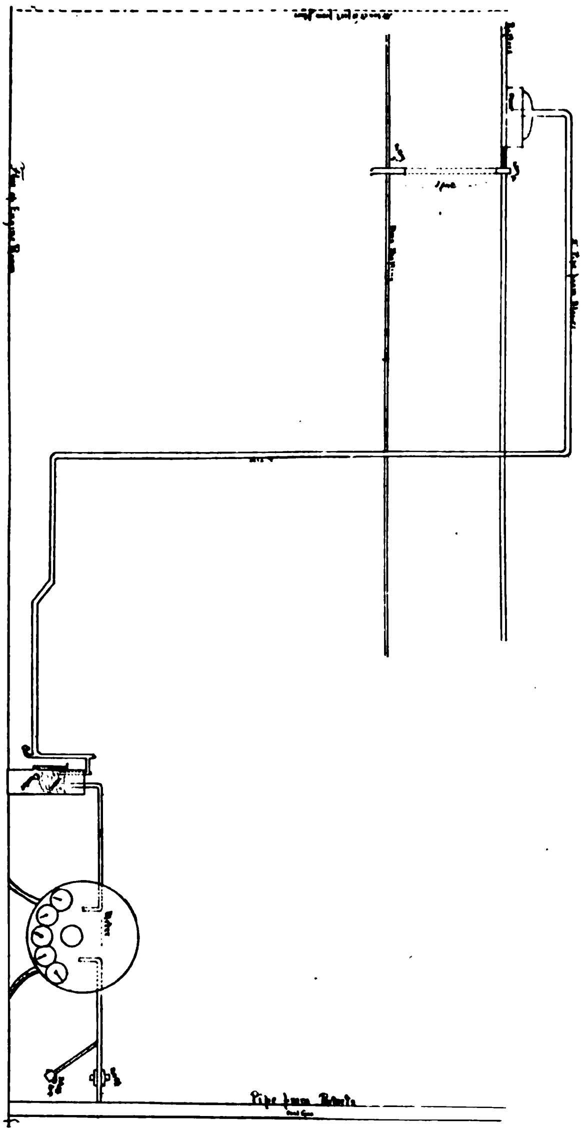
The first two changes were made on account of back pressure alone, for the gas did not show foul through the first box. In each case the pressure was normal for some time, and then began to rise until at the exhauster it was about 20 inches on a make of 40,000 cubic feet per hour. As our seals are only 24 inches, it was judged better to change than to let the pressure run higher.

Some heating had been noticed in the boxes, and then the introduction of air was stopped for a day or two. On opening the boxes about half of the content was found to be so hard that it had to be loosened up with pickaxes, and afterwards the lumps had to be pounded to pieces on the turning floor; but it should be borne in mind that the first box had not been disturbed for more than five months and the second one for seven, so that the material had plenty of time to become hard, if it had any tendency that way.

When we started on the third combination of boxes we found immediately that the first box seemed to be doing no work. The oxide was new and did not seem to attack the

sulphuretted hydrogen at all. However, we wanted to get it into shape and ran that combination until back pressure forced us to change once more. This time we found the stoppage in old oxide in the lower layer. This, which had been undisturbed for 9 months, was very hard in some places and very tarry in others, so that the gas could not get through it. The next change was made on account of back pressure, for the same cause. The last change of the year was made on account of foul gas, the new oxide once more refusing to do good work. But the net result of the 10 months' running is that we purified 127 millions cubic feet with 5 changes, or 25,400,000 cubic feet to the box, whereas our usual quantity was 8,000,000 when we did not use air; or we have made 5 changes instead of 15. We are well contented with the result.

It was a queer coincidence that, on March 6, a fortnight before the blower was put in, but sometime after it was ordered, the Mayor of Springfield appealed to the Board of Gas and Electric Light Commissioners for a reduction of the price of gas in Springfield. The hearing on the petition came on early in June, and one of the first points made by the petitioners was that a blower was in use, carefully concealed, by which 20 per cent. of air was added to the gas, and the Commissioners were urgently besought to go to the works and see the felonious machine. A discharged workman, who was a witness for the city, made the plan here shown you, and gave the Commission full details of the arrangements, though, as he is one of that class of men who believe and say that as much air will go through a half-closed stop-cock as through an open one, his testimony had only corresponding weight. But the papers took up the matter in true journalistic style, placed it in headlines above their editorials, used it in paragraphs and even published pictures of the manager and the workman regulating the air supply. To one of a scientific turn of mind nothing could be more ridiculous, though I admit that the experience was extremely unpleasant to me personally. However, I have survived the infliction and am glad to relate my experience to my associates. I hope now, that the novelty of the thing has been taken away, we managers may use the common methods of economy without any unpleasant consequences.



Discussion.

The President — Gentlemen, Mr. Fowler's very interesting paper is before you for discussion, which I hope will be an extended one.

Mr. F. B. Sherman — Will Mr. Fowler state to us the dimentions of his boxes?

Mr. Fowler — 20 by 32 feet, and the oxide lies in them 26 inches deep. Each box carries about 1,000 bushels.

Mr. W. A. Learned — What is your maximum hourly rate of flow?

Mr. Fowler — The maximum might be 45,000 feet, but the average is not much over 22,000 or 23,000. It might reach 30,000 in December and January, but it is an irregular flow. During the day, or whenever we are making water gas, our flow of gas is much quicker than at other times.

Mr. Norris — Does Mr. Fowler find any difficulty in the use of a blower in getting a constant percentage of oxygen. That is, whether he finds that running his little oxygen blower from the same counter-shaft as the exhauster results in his getting into the gas a constant percentage of oxygen, even though the exhauster be run at different rates.

Mr. Fowler — It is rather difficult to keep it at a perfectly even percentage. The blower has a large clearage, and unless it is run at a fairly high speed it does not produce enough pressure to overcome the seal and the meter.

Mr. Norris — Personally I have found much trouble with the use of that form of oxygen pump, and we are drifting in the direction of a piston pump as answering the purpose better. In the second place, I would like to ask whether in measuring his oxygen he uses a wet or a dry meter.

Mr. Fowler — A wet meter.

Mr. Norris — Do you find any trouble from the rusting of the drum?

Mr. Fowler — It has not yet been in use long enough to give us any trouble in that way. It has been in service only since last March.

Mr. F. C. Sherman — It is a well established fact that the slower we pass our gas through the purifying material the better the result. A portion of the very excellent results which

Mr. Fowler has obtained can be attributed to the very large size of his boxes as compared with the work which he is doing with them. Therefore, those of us who do not have large boxes for the business we are doing should not expect to get the results which he reports, and should not be discouraged if we cannot attain them.

Mr. Lamson moved a vote of thanks to Mr. Fowler.

Capt. McKay in seconding the motion thought they should congratulate Mr. Fowler on the progress reported by him in reducing the great cost of oxygen, for they all remembered how very much it cost when first brought forward by Mr. Brin.

The motion having been adopted, and the President having so announced, Mr. Allyn suggested that before the subject was finally passed, and that as he had heard several gentlemen inquiring in his neighborhood whether Mr. Fowler was making all water gas or a mixture of water and coal gas, it might be pertinent to have that query answered.

Mr. Fowler —We made during that time probably about and certainly not more than 25 per cent of water gas.

Mr. Walton Clark — I would like to say on this subject that I believe the use of oxygen, whether in the form of air or otherwise, in small percentages in the gas as an aid to purification, is beneficial alike to the gas company and the consumer. It results in a better quality of gas, less smell round the works and a somewhat reduced cost of gas.

The President — Gentlemen, we all thoroughly agree with Mr. Walton Clark in that statement. It is the general practice both here and abroad. It goes without saying.

Mr. Sherman — I should like to give the members the benefit of my experience with iron oxide purification during the past year, an experience which cost the New Haven Gas Light Company a good deal of money and its engineer a great deal of anxiety. One year ago we were changing our boxes nearly every day, and the material purified a little over 1,000 feet to the bushel. We changed the composition and carried it up from 15 per cent. to 40 per cent. of iron per bushel. We changed off to the Connelly iron sponge. We also imported some bog ore from Canada. We obtained no relief from these changes. I sent my assistant around to some other works of

about the same capacity as our own to get some suggestions which would remedy the trouble if possible. We obtained none; in fact, we found one large works passing through the same experience which we were, and that had a large number of men changing the material in the boxes every day. Finally, a brother engineer suggested that we raise the temperature of the purifying room and of the gas entering the boxes. Previous to this we had paid little attention to the temperature of the room. On raising the temperature of the room to 70° and the temperature of the gas entering the boxes to 68°, we found a very marked improvement. Instead of changing the boxes every day, we only changed 3 boxes during the month of December. Now this may seem a very small matter to many of the engineers present, but to us it was a very serious matter at the time. If my experience in this instance shall be of any aid to any of the members present, I shall have accomplished my object in calling your attention to the temperature of the purifying house and of the gas entering the boxes.

The President — We will now listen to a paper by Mr. Carroll Miller, of Newark, N. J., on

The Proportion of Sulphur Removed in Each Purifying Box.

The object of the experiments described in this paper was to determine the proportional amount of sulphur in the form of sulphuretted hydrogen (H_2S) removed from the gas by the oxide of iron in each box in a set of four.

The apparatus used for determining the sulphur in the gas consists of a graduated burette of a capacity of about 112 cc. On the top of this burette is a 3 way cock, which establishes communication between the burette and a hose nipple, through which the gas is introduced, and between the burette and a cylindrical vessel, of about 10 cc. capacity, graduated to $\frac{1}{10}$ cc. This graduate is situated on the top of the 3 way cock. A cock is on the bottom of the burette for the purpose of introducing or ejecting the liquid used. The whole apparatus is made of glass.

The burette is first filled with starch water, then 100 cc. of the gas is introduced, thus displacing the 100 cc. of the starch water and leaving about 12 cc. in the bottom of the burette. The 10 cc. graduate is filled with a standard solution of iodine

in water. The 3 way cock is turned so that the solution gradually enters the burette. The iodine combines with the sulphuretted hydrogen to form hydriodic acid and the sulphur is set free. Thus $2I + H_2S = 2\ HI + S$.

When all the H_2S is decomposed, the starch water in the bottom is seen to turn blue, then the cock is shut off and the amount of the solution used is observed. The reason that the starch water turns blue is that when all the H_2S is decomposed, iodine drops into the starch water, and according to the well known chemical fact, the chemical reaction between the iodine and starch forms a blue solution. 1 cc. of the solution used in these tests indicated the presence of 100 gr. of sulphur per 100 cubic feet of gas.

The apparatus is designed so that the tests may readily be made in the purifying house. The possible error is as high as 15 grs. This does not materially alter the percentage found.

I am indebted to Mr. J. M. Ruegenberg, one of my assistants for the able way in which he performed these experiments.

I have selected at random a set of results for coal gas, taken between "changes."

Coal Gas.—Size of boxes 24 feet by 30 feet, with 1 layer of 30 inches of oxide in each box. Steam coils are in the bottom of each box. Throughout these tests the temperature was kept practically constant in each box as follows: Outlet of first box, 84° F; outlet of second, 78°; third, 70°, and last, 64°. No air was admitted into the gas.

TABLE I.—COAL GAS.—*Grains of Sulphur per* 100 *ft. of Gas.*

Day	Foul	Outlet of Box Nos. 1	2	3	4	Rate of Flow of Gas. Per Hour.
0	462.5	132.5	20	0	462.5	. . . .
1	475	180	23	0	off	43,500 cubic feet.
2	465	205	22.5	0	off	42,500 "
3	490	280	45.5	0	0	42,500 "
4	672	333	73	10.5	0	36,000 "
5	620	337	122	10	0	42,500 "
6	421	284	83.5	11	0	45,000 "
7	430	292	85	16	0	45,000 "
8	435	307	92	17.5	0	43,500 "
9	423	off	112	16	0	43,000 "

Tests were made daily in the coal gas for a period of about two months. Samples of gas were taken from the inlet of the first box and from the outlets of each of the four boxes.

Gas at the outlet of No. 3 discolored acetate of lead paper on the 7th day. The variation of sulphur contents of the foul gas is due to change of coal.

The method of running is to always have the gas passing through four boxes, except when it is necessary to refill one of them. Gas from the outlets of the first 2 boxes will discolor acetate of lead paper.

A day or two after the third one shows foul a change is made, thus having two clean boxes, except when one is being filled with oxide.

Table I shows that the first box removed 43.8 per cent. of the sulphur between changes, and was still removing 29.4 per cent. (128 grains) when a change was necessary; the second box removed 41.8 per cent. between changes; the third box 11.8 per cent.; the fourth 1.6 per cent.

The averages of the tests made during the time between November 26, 1900, and January 26, 1901, give the following proportions:

TABLE II.

Sulphur removed in first box	44.6	per cent.
" in second box . . .	44.2	"
" in third box	10.4	"
" in fourth box . . .	.8	"
	100.0	

During that time seven changes were made, and in only one case did the first box show the same amount of sulphur at the inlet and outlet at the time of changing. The boxes then showed as follows:

Sulphur in foul gas	462.5	grs.
" at outlet of first box	462.5	"
" " second box . . .	132.5	"
" " third box . . .	20	"
" " fourth box . . .	0	"

The most sulphur that was being removed by the first box at the time of a change was 29.4 per cent. (128 grains), and the average for the seven changes was 18.3 per cent. (82.2 grs.)

The average rate of gas per hour for the two months was 46,700 feet; the highest 51,000 feet; and the lowest 39,000 feet.

Unfortunately, at the present writing, no complete set of tests for the water gas boxes are available on account of their being only two changes made during the two months and the failure to make some tests. I will give in Table III. the results of tests which were taken but 13 consecutive tests, for as many days are missing.

Water Gas.—Size of boxes 30 feet by 36 feet, with one layer of 30 inches of oxide in each box. Steam coils are placed as in the coal gas boxes. The temperatures were as follows: Outlet of first box, 75° F; outlet of second, 69°; outlet of third, 65°, and outlet of fourth, 62°. No air was admitted into the gas.

TABLE III.—WATER GAS.—*Grains of Sulphur per 100 Feet of Gas.*

Day	Foul	Outlet of Box Nos. 1	2	3	4	Rate of Flow of Gas Per Hour.
0	200	58	20	0	180	. . . .
1	194	70	22	0	off	98,000 cubic feet.
2	194	90	23	0	off	153,000 "
3	198	105	24	0	0	169,000 "
4	186	100	28	0	0	152,000 "
18	196	105	25	2	0	123,000 "
19	184	105	27	2	0	82,000 "
20	187	105	25	3	0	84,000 "
21	180	110	27	3	0	89,000 "
22	192	96	24	3	0	87,000 "
23	200	157	27	2	0	188,000 "
24	194	167	25	3	0	165,000 "
25	182	170	26	3	0	156,000 "
26	235	100	27	18	0	162,000 "
27	221	212	30	19	0	95,000 "
28	212	off	35	20	0	109,000 "

Gas at the outlet of No. 3 discolored acetate of lead paper on the 26th day. The variation in the sulphur contents of the foul gas is due to change of coke in the generators. The method of running it the same as in the coal gas.

Table III. shows that the first box removed 35.1 per cent. of the sulphur between changes, and was only removing 4.5

per cent. (10 grs.) when a change was necessary; the second removed 51.8 per cent.; the third 11 per cent., and the fourth 2.1 per cent. These percentages are misleading as the 13 tests are left out. No. 1 would show higher and No. 2 lower. I will not give the averages for the two months for the same reason as above.

From the above results it would seem that it is the best practice to pass the gas through four boxes.

Referring to Table 1. If three boxes were on, and it was desired to have one clean box in the series, great care would necessarily have to be taken to get on the fourth box as soon as No. 3 showed foul. By this method, which seems rather risky, as much work could be gotten out of the first box as with four in the series.

If three boxes were on, and it was desired to have two clean boxes in the series, considering 2, 3 and 4 in Table I. to be the three boxes, and the gas at the outlet of No. 1 to be the foul gas, No. 2 removed 75.4 per cent of the sulphur between changes and was still removing (considering 307 grs. in the foul gas) 70.0 per cent. (215 grs.) when a change was necessary.

The second box removed 21.7 per cent. between changes; and the third 2.9 per cent. This case is in favor of the 3-box system, as the gas assumed as totally unpurified averages 55.3 per cent. (224 grs. per 100 feet) lower in sulphur than the "foul" in table I. If the "foul" entered No. 2 a change would probably be necessary at the end of two or three days. A change in the rate of flow of gas through the boxes will alter the above proportions, but the general scheme will hold good.

Discussion.

The President — Gentlemen, so far as the Association is concerned at least, and within my memory, this seems to me an original line of investigation, or at least in its presentation, and I am sure that you will be interested to discuss it fully. I would like to ask Mr. Miller myself if this device that he has arranged is applicable in a practical way for regulating changes, to ascertain when changes should be made.

Mr. Miller — Yes, you can tell after experience just how much H_2S it would take to discolor acetate of lead paper. But I would not test the last box that way, because as I have

noted in my paper, you may make an error of 15 grains, so there is a risk of letting 15 grains pass through the last box.

The President — Wouldn't it be valuable in ascertaining how a new batch of oxide might be working in the first box?

Mr. Miller — Oh, yes; there is no doubt it is very valuable; but I mean, to use the apparatus to test the last box would be rather risky, because there is danger of letting sulphur into the holders.

Mr. Norris — To me the principal interest in this paper is the argument that it presents in favor of using four boxes. With the ordinary centre seal of course only three boxes can be used at one time, and under normal practice a change is made when the second box shows dirty. With the valve system that Mr. Miller has, on one set of boxes, and the special centre seal in the other, it is possible to use the fourth box as a catch box. The result is, as shown in these tables, that the foul box is not turned off until it has almost ceased to absorb sulphur. In a rather incomplete set of experiments made at several other works it appears that, with the 3 box system operated in the normal way, when the second box shows dirty and it is necessary to make a change, the first box is still absorbing on the average about 50 per cent. of the sulphur. These investigations are of interest, too, because there has recently been a movement in the direction of using boxes in series of two only, and this piece of apparatus used by Mr. Miller has afforded us a means of investigating just what does take place in the purifying boxes and in the preliminary scrubbing and condensing apparatus.

The Secretary — I would like to ask Mr. Miller if he considers, with these two statements, where the acetate of lead in the paper showed about 18 in one case and 16 in the other, that it is probable there is up to that amount of sulphuretted hydrogen passing, even when the gas showed clean by the lead acetate test.

Mr. Miller — I would not like to make any statement, because I have not made any experiments to verify the amount. I might have added there that with the solution of iodine and water it is necessaay to use a little potassium iodide in order to cause the iodine to dissolve. Iodine does not readily dissolve in pure water.

Mr. Nettleton — I want to congratulate Mr. Miller on the success of his paper and on the success of the undertaking. It has always seemed to me that testing with acetate of lead paper was a very crude method, and those of us who have followed it out at all carefully know that there are "ways and ways" of testing. As I understand Mr. Miller, this apparatus gives us a very close approximation of the quantity of sulphuretted hydrogen contained in the gas. May I ask Mr. Miller if the operation is at all difficult, or if it takes any great length of time?

Mr. Miller —No; the whole operation to make five tests never takes more than an hour at the outside.

Mr. Nettleton — Then it is a matter of not over 15 minutes to a test?

Mr. Miller—Yes, sir.

Mr. Nettleton — And the apparatus is not expensive?

Mr. Miller —No; I don't remember just what it cost, but it is not expensive.

Mr. Nettleton — And easy to operate by the men?

Mr. Miller —Yes. It is in a portable case, so it can be carried readily. The whole work is done in the purifying house.

The Secretary — As the subject of the 2 box system has been referred to, personally, I should be very glad to hear somebody stand up for that system.

The President — We should like to hear from 2 box advocates. Those who have 4 boxes seem to have a monopoly.

Mr. Allyn — Perhaps Mr. Ramsdell might give us some information.

Mr. Ramsdell — I think the only thing to be said in this connection is that the whole question hinges upon the amount of work that is required to be done in the boxes, or, in other words, the amount of work that is performed between the hydraulic main and the boxes If a part of this purification is performed in the passage of the gas through the apparatus before it reaches the boxes, very naturally not so much work will be done in the latter. I think that is the correct way to look at it.

The President— If no other member desires to further discuss the matter, I am sure you will endorse my extending the

thanks of the Association to Mr. Miller, to whom we are very much obliged for coming so far. It has certainly been of advantage to us to get the information, and I hope it will pay him in coming so far to meet us. I think it well, gentlemen, to depart somewhat from the exact order of our programme. If Mr. Walter S. Allen is in the room I would like to call upon him for what he has to say in regard to gas lighting at the Paris Exposition. We are all very glad to welcome Mr. Allen back amongst us. We know that he held a distinguished position in the Gas Commission of Massachusetts, as well as being equally or more greatly distinguished in representing this Association at the Paris International Gas Congress. We welcome you back, Mr. Allen, and shall be very glad to hear from you as to what you found about gas lighting at the Exposition and in the city of Paris as well.

Mr. Walter S. Allen, of New Bedford, Mass., then read the following paper on the

Gas Lighting at the Paris Exposition.

The most important and most interesting exhibit connected with gas lighting at the Exposition was the lighting of the grounds of the Trocadéro and the Champ de Mars by incandescent gas lights. These areas lie on the opposite sides of the river, and were wholly lighted by gas, excepting the bridge crossing the river. The total length is about 3,500 feet, and the width is approximately 500 feet. This entire district was supplied with light by the Paris Gas Company, using both gas at normal, of about $1\frac{3}{4}$ inches, and gas at a pressure of 8 inches. Bandsept burners with Welsbach mantles were used on a portion of the lights, and Denayrouze burners were employed on others.

Using gas at normal pressures, there were in the Champ de Mars 495 lamp posts, with 800 lanterns and 1,900 mantles, and in the Trocadéro 455 lamp posts with 610 lanterns and 1,400 burners, these giving together a light of about 600,000 candles. Using the compressed gas were 140 lamp posts in the Champ de Mars, with 240 lanterns and 1,200 mantles, and in the Trocadéro 50 lamp posts, with 100 lanterns and 500 mantles, giving together 400,000 candles, or a total light effect of 1,000,000 candles, using about 50,000 feet per hour.

These lamps were arranged in different ways, some of the lanterns having only 1 burner, others 2, others 3, others 5, and

some of those with compressed gas had 10 mantles in 1 lantern. The consumption of the burners using compressed gas was 12.3 feet each per hour, and of those using ordinary gas, the larger groups used burners consuming 8.8 feet, and the smaller ones used burners consuming 10.6 feet. The large groups of burners were placed in lamp posts which were higher than the ordinary posts, and were provided at the top with reflectors, The effect of this illumination was far greater than that shown by electricity in any part of the exposition, and it was one of the few things which was ready at the opening of the fair.

In addition to this use of gas the ordinary lines of gas jets along the cornices of the buildings were used for almost all of the buildings in the Champ de Mars, only a very small section of each building immediately on the two sides of the electric fountain being supplied with electric light. On nights of illuminations, when all the electric lights were burning and the illuminated fountain was being shown with all its varying colors, the lines of gas lights along the tops of the buildings stood out very brilliantly, and, on account of the little quiver produced in the light by the wind, presented a much more artistic sight than was the case with the electric lights, which seemed to burn dim and yellow.

Outside of the Exposition, too, gas seemed not only to be holding its own in Paris, but to be making gains. For the illumination of the 14th of July (the French 4th of July) gas was used far more extensively than was electric light, and the buildings outlined by gas flames and bearing devices of all kinds were the most attractive to be seen. The long, straight line of the Louvre carried along its entire cornice a row of gas flames, the top of the Chamber of Deputies bearing a large sunburst with the initials of the republic, "R. F.," and the long line of the Champs Elysées was marked out by lines of gas lights run from one lamp post to another the whole distance, each light being provided with an opal globe; and under the trees this gave a far better effect than any of the festoons or arches of electric lights which were found on the Boulevard.

Paris itself is lighted almost entirely by incandescent gas lamps, some of the smaller streets still having the ordinary flat flame burner, but all the more important ones have been furnished with incandescent lamps, sometimes single lamps and

sometimes two in one lantern. The lighting of the Place de la Concorde, perhaps the best lighted square to be found in the world, is wholly carried out with incandescent gas lamps.

When we consider the exhibits themselves, apart from this grand exhibit made by the Paris Gas Company, we do not find much that is especially novel or interesting, but there were certain things which merited attention. First of all was the so called Gas Pavilion, in which were collected a large number of pieces of apparatus devised for the use of gas, none of which presented any great novelty, although their methods of construction varied from those in use in this country. The second story of this building contained a large assembly room, and photographs of gas works and statistical charts. The more important exhibits were shown scattered about the Exposition.

The French Gas Meter Company showed several interesting pieces of apparatus, but in general there was little that was novel.

The Stettiner Chamotte-Fabrik, in combination with the Berlin Anhalt Machine Company, showed a model of gas works, on a scale of 1 foot to 5, showing a plant with 5 benches of 9 inclined retorts and automatic machinery for landing coal and coke. This plant, which was not a copy of any existing plant, but was practically designed to be erected in a Swiss city of about 50,000 people, was arranged so that the coal should be taken by an elevator and band conveyors, either directly to the retort house or to the coal shed, or taken from the coal shed to the retort house. To arrange this for the greatest economy of power and labor the plant was divided into three parts; a large middle hall, into which the railway cars could run directly, to one side of this the retort house proper, and on the other the coal sheds.

The coal shed was built on the hopper form, and was arranged so that the coal should be fed on to the conveyor band by means of a slide and a movable chute, which has a to and fro motion given to it by the band itself. The coal is brought by an elevator into the charging wagons on an overhead rail in front of the furnaces, and the coal is charged by chutes into the retorts. It is claimed that one man can attend to the entire charging of these 5 benches.

The retorts are inclined, set on the Coze system, with regenerative furnaces. The coke is discharged against a screen

which prevents it from falling on the floor, and leads it into a coke conveyor, which is a long trough partly filled with water, in which moved two chains connected at intervals by rods, and which drags the coke along. This quenches the coke thoroughly, and it is then carried by another conveyor to the breaker, and from the breaker by an elevator to the sorting sieves and into the coke bins, ready for distribution.

The compactness of the entire plant is very noticeable. This model was actually shown in operation, the machinery being moved by an electric motor. Of course the coal storage capacity would not be sufficient for a place where a whole winter's storage of coal was kept on hand, but this part of the plant could easily be extended.

In the French section was shown a model by Coze of his system, which did not vary greatly from the one which has been described. The Paris Gas Company also exhibited a large collection of drawings, plans and photographs of their various stations, and especially their method of handling coke.

Another set of exhibits which were interesting were the gas engines. These were exhibited by almost every country and were of a great many different forms. The Otto Gas Engine Company showed its engines in connection with an ice making plant, using both gas engines and engines using petroleum, the idea being to allow the installation of such plants in country houses. These were in operation.

A small gas motor by a French maker was the principal aid in installing the large and heavy engines and electrical plant in the Machinery Building at the opening of the Exposition. The boilers had not been set in place and no steam was furnished, so that this small gas engine, which was employed to run some dynamos to furnish electricity to operate two large power cranes, was run steadily for several weeks as the only source of power in the entire building.

Among the gas engines the most interesting was the large engine of 1,000 horse power, by Cockerill, of Seraing, in Belgium. This was a single cylinder engine, intended for the use of blast furnace gases, and arranged to operate a blowing machine for the use in the same blast furnaces. The blower was connected directly to the opposite end of the piston, and this machine, which had only one cylinder, was able to develop, with furnace gases, 700-horse power, the use of illuminating

gas giving, 1,000-horse power. This machine had a cylinder diameter of about 50 inches, and a stroke of 54 inches, and occupied a space including the blower, of about 20 feet by 55 feet, and stood about 14 feet high. About $\frac{2}{3}$ of the length fell to the engine. A very considerable number of these engines have been sold for use with blast furnaces.

The only other point of interest to gas men was the acetylene exhibit. This was divided, a portion being in Vincennes and a portion in the Invalides section; and, in addition, two different types of electric furnaces were in operation, making carbide of calcium, in the Champ de Mars. Along the banks of the Seine for a portion of the way a number of acetylene lamps were burned to add to the illumination, and at Vincennes, and throughout the construction period, before power was furnished and the electric lights used, portable generators furnishing acetylene were used all over the grounds.

I doubt if American gas men realize the extent of the business development of acetylene on the Continent of Europe at present. Large numbers of small towns of from 2,000 to 3,000 inhabitants have put in central station plants to furnish acetylene, and in some cases this gas is carried through 4 miles of mains to supply the village. In addition to this there are a great many isolated plants lighting small hotels, country houses and small farms scattered throughout Germany and France, and the business has become sufficiently important to support several trade journals devoted entirely to acetylene. Although there have been a number of accidents, still there are a great many perfected devices for generation and storage, and it has been proven that almost every case of accident was caused by gross negligence. Unfortunately, when an acetylene explosion does take place it is usually of such violence that it is sufficient to destroy buildings and produce loss of life, so that the authorities immediately have their attention called to it.

One interesting exhibit, which is on the point of being commercially exploited, while not a gas exhibit, still is of interest to all who have electric light plants. This is the Nernst lamp. This lamp, which has for its filament a thread of the rare earths such as are used in the Welsbach light, does not require any exhausted bulb, as is the case with the carbon filament, nor does it require any bulb unless it is desired for pro-

tection. This filament is of high resistance to electricity when cold, but if warmed the resistance becomes lower, the current passes and the filament glows just as a carbon one does. In order to light the lamp the current must be turned on and a match or an alcohol lighter held for a few seconds under the filament, which soon begins to glow and rapidly reaches its full light effect. If a closed bulb is used a heating coil of platinum wire surrounds the filament; this begins to glow as soon as the current is turned on, and soon heats the earthy filament sufficiently for the current to pass. As soon as the filament is in full glow the current, passing through the platinum coil, is automatically shunted out.

The commercial exploitation of this has not yet begun, and the price of the filament I was unable to ascertain, but I was assured that it would be very low; and as all that is necessary to replenish a filament which is burned out is to slip it out of its sockets and slip in a new one (a matter of 10 seconds) it would seem, if the cost is as low as it is expected to be, that this form of lamp would be of very considerable importance.

All in all, while there was comparatively little strictly novel, the illumination of the Exposition, as shown by gas and by electric light, makes it clear that when gas is properly used and arrangements made to utilize it to the best advantage, there remains open a large field in which by its cheapness gas need not fear the competition of electricity. The experience of the city of Paris in lighting its streets and open squares with gas, and under the high cost of gas in Paris)$1.70 per 1,000) and the relatively moderate cost of electricity, 18 cents a kilowatt hour, shows gas to be quite as economical, and the light to be better distributed by means of Welsbach lights than is the case when arc lighting is employed; and I think no one will question the superiority of Welsbach street lighting over incandescent electric lighting.

Discussion.

The President — I think we can all appreciate that if the French are a little slow about reducing the cost of gas, they are not slow in the way they utilize it. I think it would startle our American friends to hear of gas at $1.70 per 1,000 in such a large city as Paris. I am sure Mr. Allen has a great many points that he has not put on paper, although he has

filled up completely a short one. I hope you will draw him out further.

Mr. Walton Clark—May I ask what the efficiency of the Nernst lamp is as Mr. Allen saw it in Paris?

Mr. Allen — I mislaid the notes made on that point, so I am unable to say, but my impression is they claimed an efficiency of $1\frac{1}{2}$ watts per candle, or about double the efficiency of the ordinary incandescent lamp.

Mr. Walton Clark—That is the claim made in this country, I think.

Mr. Allen—The Allgemeine Electrizitats Gesellschaft have spent a great deal of money in putting in a plant and preparing for the business, but the statement made was, they did not propose to put this lamp on the market until they should be ready to supply anybody that wanted it in sufficient quantities. They expected to be able to do it about the 1st of January, but I have not heard yet that they have really started commercial exploitation. It certainly gave a very much whiter light than the ordinary carbon filament, and seemed to work very smoothly. The arrangement by which the little incandescent filament slips in and out is so very simple that if they can furnish it at the cost talked about (not over 2 to 3 cents) it ought to make a very strong competitor for the carbon filament.

Capt. McKay — One item mentioned at the beginning of Mr. Allen's paper, which really concerns itself with selling gas, is the extent to which use is made of gas in France on occasions of festivity or celebration for illuminating and decorating at night. I have noticed it, having been present at minor expositions in a number of the cities: At Havre, when the Maritime Exposition was held; at Cherbourg, when the Centennial of the Fall of the Bastile was celebrated; and at Nice and in Paris at the time of the musical festivity and celebration. On each of these occasions it was very remarkable the extent to which use was made of gas for decorating the fronts of stores, houses, columns, triumphal arches, etc.

Mr. Allen — I must say, speaking not perhaps as connected with the gas business now, it seems to me that the gas men in the United States don't realize in any degree how it is possible to use gas for illumination on public occasions. Not only in England but in France, and wherever else one goes on the

Continent, whenever there is a fête of any kind there is always a large use of gas for illumination. The large public buildings, such as the ones I referred to, the Ministry of War, the Louvre and the Chamber of Deputies, all seemed to have lines of gas piping along the cornices, which is put in place and used very freely at the time of any public celebration. The lights along the Champs Elysée, which were used only on the 14th of July, were stretches of gas pipe connecting every pair of lamp posts for the whole length of the street. These lights had opal globes over ordinary flat flame burners, perhaps a foot apart from center to center of the globe, and gave an effect to the lighting which was not secured by any of the uses of electricity that I saw anywhere in Paris. Then at the fêtes during the Exposition, where electricity and gas were both very freely used, the large lanterns used in the Champ de Mars section were often covered with paper screens of various sorts. For instance, at the time of the Vintage Festival they represented bunches of grapes, and at the time of the Flower Festival they were in the shape of chrysanthemums and roses. The ordinary street lanterns or lamps on posts were used in the same way for illuminating purposes that we are used to seeing electric lights used, covered with colored papers. It seems to me there is an opportunity in almost any city, at very small expense for gas pipes, to arrange for such things and to keep such gas pipe on hand, so that it can be used not only once but a good many times.

Vice President Learned was called to the Chair.

The Chairman — Gentlemen, would you like to discuss the paper further?

Mr. Walton Clark — Mr. President, perhaps Mr. Allen will say something regarding the use of gas stoves for heating and cooking as he saw them in Paris, if there were any on exhibition. I did not hear all of Mr. Allen's paper. Possibly he did speak of them before I got in; if not, I would like to hear from him.

Mr. Allen — I said very little about the use of gas stoves and the expense of same. These were exhibited in almost all varieties and from almost all countries. The Paris Gas Company made an especially elaborate demonstration of them. Speaking of gas stoves, perhaps it is better to speak about the gas stove as it is used particularly in Paris. It is almost ab-

solutely necessary for the owner of the apartment to furnish the apartment with a gas stove, and it is very rare if any of the better classes of apartments that you do not find in the kitchen a gas stove as well as a coal stove. I lived in apartments when in Paris, and in hunting up those I found that that was universal — the equipment of the kitchen with a coal stove and also a gas stove, not always in combination; but still in the newer parts of the town, almost invariably a combination range, having a gas stove portion, was to be found. Of course, the development of the use of gas for cooking in Paris has been very large, owing to the high price of coal. The ordinary coal used in Paris for domestic purposes rarely falls below \$13 a ton, and during this last summer it reached \$16 a ton. Even with the high price of gas at \$1.70 per 1,000, and the economical arrangement of the ordinary French range, which uses very much less coal than the American type of range, gas is found to be very economical for cooking purposes. For heating I doubt if much is used. Nearly all the larger departments have the hallways, and to some extent among the newer apartments, the apartments themselves, heated from a central furnace, and in the houses there is never any gas except in the living rooms. None of the bed rooms have any gas or even have any coal fires. The heating of a French house is almost entirely done by coal or by wood; but the use of gas for cooking is fostered in every way by the Paris Gas Company. The Company is also trying in every way to get the use of gas extended in small houses. It is putting in and supplying a gas stove, a meter, the risers in the apartment houses, and a certain amount of fittings, in all apartments of which the rent does not exceed \$100 a year, free of charge. If the rent is higher than \$100 per year the owner is expected to pay for a certain part of the cost of installation or for the whole of it, but in the cheapest class of apartments the Company supplies all these appliances free. Of course, the Paris Company is now engaged in a very bitter contest with the government, its franchise running out in 1904, and with the very poor form of existing contract, under which it has to divide ½ of its net earnings beyond a certain amount with the city, it requires the consent of the City Council to reduce the price of gas. The Company has desired for a number of years to reduce the price, but the city has opposed it. Now the city wants the price reduced, but does not want

to give any advantages in the extension of this contract. The Company has made an offer to make the price $\frac{2}{3}$ of what is was, beginning with the 1st of January of this year, in consideration of an extension of the franchise until 1925; but that had been refused by the Council, and when I left Paris matters were still where they were before. The extended use of gas in Paris is undoubtedly very much hampered by this very high price, high even in relation to the high price of coal.

The Chairman—Somebody has suggested, Mr. Allen, that you say something in regard to the high pressure burners that are in use for street purposes in Paris. Can you give us any information on that point?

Mr. Allen—Unfortunately I cannot give any detailed information regarding those used in Paris. The burners that were used at the Exposition were of the Denayrouze air mixing type of burner, which I don't think has been used anywhere in the streets in this country as yet. I think Mr. Shelton has looked into that matter a good deal more thoroughly than I have and probably could give more information.

The Chairman—Mr. Shelton, can we hear from you on that matter?

Mr. Shelton—I am sorry to have to reply in the negative. The high pressure work with which I have been identified has been mostly the conveyance of gas considerable distances under high pressure (several pounds), and converting it then to the ordinary low pressures. I have no figures on the working of burners at the ranges of 8 or 10 or 15 inches pressure, such as have been referred to.

On motion of Mr. Nettleton, seconded by the Secretary, the thanks of the Association were tendered to Mr. Allen for his interesting paper.

At this point the Secretary read a telegram from Mr. C. M. Higgins of New York, expressive of congratulation and good fellowship, and of regret that he could not attend the meeting.

The Secretary having made an explanation as to the ways and means of obtaining tickets for the annual dinner, and urging upon the members the necessity of applying for the same early so the hotel people would have ample notification, further said:

The matter referred to in the President's address, of getting autographs attached to the records, which is provided for in the

Constitution as part of becoming a member of this Association, that the signature shall be affixed to this book, has been somewhat neglected, and there are a good many members whose names are on the rolls, whose autographs are not on the book. The book is here, and if members will kindly come and sign it they will comply with the requirements.

President Addicks then resumed the Chair and said: As it is now nearly the hour for recess, it is suggested that the remaining minutes be devoted to a look into the contents of the question box.

No objection being offered, the Secretary read the following questions:

"Is the Use of Prepayment Meters Increasing; and Does it Pay?"

The President—This should be an easy question to answer. Mr. Nettleton, would you like to say something in reply to it?

Mr. Nettleton—I have talked so much that I dislike to speak again; but I may say I believe personally and very thoroughly in the prepayment meter. At Derby, where I have been pushing it for a number of years, we commenced in the fall of 1896, and by the following April as I remember we had 17 meters. We now have about 1,300 in use. The percentage of prepayment meters to the total number of meters is, as I remember, 45. It has enabled the Derby Gas Company to reach a class of consumers to which I had never expected to sell gas. The working people, the people with very limited incomes, families whose heads earn from $1.50 to $2 a day, are, as I was going to say, very generally using gas, largely for cooking purposes; and the tendency with many of those families is to use it also for light to a limited extent. For several years it has been our practice, with almost all the ranges we have sold, to put a bracket, furnishing it free, at a convenient point near the stove, and we have found that that burner has been used a great deal, and in good many cases that or something else has led to the piping of these houses and putting up fixtures generally through the house. Of course the prepayment meter costs more than the ordinary meter. I have been into the matter somewhat carefully, and think interest and depreciation on the extra cost can be covered by 50 cents. I do not think that that covers the extra cost of repairing the meter, over the ordinary meter, but

the extra cost of that certainly will not exceed 20 cents per year. Now, the care, the taking of the money from the meters, entering it on the collection books, and then putting it on the prepayment consumers' ledger, does not exceed, and I think it is materially less than 72 cents per year. That will make at the outside $1.42 per meter per year. I believe with 2,000 meters that the amount would be materially less. Now, for ordinary meters the taking of the statements, bringing them into the office, making out the bills, collecting them, adding in the losses and the annoyance that men are subjected to by sending out time after time, it seems to me must cost very much more than the $1.42 per meter per year, which I have named. And then, beyond that, you do away with friction with your customers. It is a cure-all for the chronic grumbler. As I said when I started out, I want to repeat that I believe thoroughly, Mr. President, in the use of the prepayment meters.

The President—Mr. Nettleton, I am very glad I called upon you for the sake of the Association. I had a case yesterday where I had decided to put in a prepayment meter where we would not ordinarily do it — that is to say, in a new building — because we prefer to put in the ordinary meters merely on the question of the capital charge, which is quite essential with us. The occupant said: "Well, if I cannot have a prepayment meter I'll put in electric light." So he got the prepayment meter. We would like to hear from some one from the West.

Mr. Pratt (Des Moines, Ia.)—Mr. President, with us I think I can say the number of prepayment meters is increasing. It has gotten to that point now where we are endeavoring to check the use of prepayment meters, except among that class of consumers to whom Mr. Nettleton referred — the poorer people. We find that the desire for its use has extended to the point that people who are amply well to pay their bills are desirous of having prepayment meters. I believe the prepayment meter pays for the reason suggested that it appeals to the poorer class of people, those who have been possibly in the habit heretofore of hanging out their gasoline card and paying for 5 gallons of gasoline in advance. It enables them to become users of gas under the same general regulation or plan that prevailed when they were buying gasoline.

The President—Mr. Sherman suggests that Mr. Learned, of Meriden, Conn., could give something of interest on this subject.

Mr. C. A. Learned—I do not know that I can add anything to this discussion. I believe in the use of prepayment meters, and have a number of them. We rather think that the use of one kind is better than to have a number of sorts, and they are in every respect a success. The question comes up with a great many managers whether or not the price with prepayment meters shall be more than that through the common meter. The net price charged affects everybody. That is, if the price, for instance, is $1.25, then the meter may be set exact with some makes; with other makes it may be set within 2 or 3 cents of the amount. As it happens, in Meriden our price is such that we set our meter 3 or 4 cents in advance of the regular price. We think it is an advantage, and they work more satisfactorily. I don't think that I can add anything to what has been said. We are very much in favor of them, but we will say that to our better class of consumers we are checking a little. We have a good many applications from people who have used gas for a number of years in the regular way asking us if they may not have a prepayment meter. We explain to them why they had better not have it, and they go away satisfied generally.

Mr. Barnes—Mr. President, I should like to ask Mr. Nettleton and Mr. Learned also whether they have had any trouble from the breaking into of the cash boxes and the appropriation of the money deposited. I should also be glad if Mr. Learned would state what the reasons are that he gives to his better class of customers for not having prepayment meters.

Mr. C. A. Learned—The better class of customer, the Company working on a discount, comes to the office regularly and pays within a period, and we are not anxious under those circumstances to have him change over. Breaking into cash boxes with us has been very limited. Once in a while a 5 cent piece is squeezed in; but that is generally redeemed. Occasionally a thin portion of a meter inlet, that covers the inlet or outlet, in being shipped from the manufacturer to us is found and slipped in, but those happenings with us are rare. I will, however, admit that in large cities there is great deal of trouble with the prepayment meter.

The President—It was not quite clear to me, and I presume it was not to Mr. Barnes, this reason that you gave to the better

class of consumers why they should not have a prepayment meter.

Mr. Barnes—I inferred from what Mr. Learned said there were certain reasons that could be given showing why it was to the advantage of the better class of consumers not to have a prepayment meter. These reasons I would like to have repeated.

The President—I also would like to have some assistance on that score.

Mr. C. A. Learned—A good many reasons are given to different customers, and they may not always be just the best reasons. One simple reason is to state to the party that these meters are given out to the poorer classes of consumers, whereas the applicant of the other class who has always paid his bills very promptly is under no particular obligation in an ordinary business way to go into his cellar and deposit a quarter when the gas is exhausted. Again, sometimes they would find that in the house they had no bill smaller than a 1, 2 or 5, so they would be obliged under those circumstances to go to their neighbor (laugher). There are a good many reasons, but perhaps these two will suffice.

The President — Perhaps Mr. Learned means the neighbor would rather enjoy loaning milk, but when it came to loaning money he might object.

Mr. Walton Clark—Mr. Nettleton gave as one of the reasons in favor of the prepayment meter that it helped keep the chronic grumbler away from the office. I believe most complaints registered at the gas office are due to bad burners and local service. I would not like to do anything that prevented a grumbler from coming round and having it out at the office. I think it is for the good of the service that any man who feels discontented should come to the office and tell his tale at the complaint desk, in order that he may be shown that the service can be good, and that the gas company intends to have the service right and will so make it upon complaint.

Mr. Nettleton—I did not wish to be understood as saying that it prevented the chronic grumbler from coming to the office. Nor did I intend to be understood as saying that it did away with all complaints from the chronic grumbler. In *most* cases this prepayment meter does away with the cause of complaint. As answering other questions asked, I would say I think there

have been six cases of robbery in the five years that we have had prepayment meters, and the loss has been very trifling.

Mr. Browne—It was only last evening I read that beautiful story of a man who told the children in his neighborhood that the prepayment meter was a savings bank. I should like to know whether the gentleman is present who owned that meter?

Mr. Pratt—We have a colored citizens' church in our town which makes a collection for the benefit of the prepayment meter a part of its service. I would also like to say to the gentleman who made inquiry if prepayment meters were ever broken into, that we have not only had a few meters broken into, but we have had one of our prepayment meter collectors held up to the tune of $220.

Mr. Barnes—We have not any colored citizens' church in our city that uses the prepayment meter, but we have one in which I wish a meter could be placed. We should have less trouble collecting the bill, I think.

The President then declared a recess, to terminate at 2.30 P. M.

AFTERNOON SESSION.

The Association reassembled in afternoon session, pursuant to the motion for recess. The President announced that the first business in order would be another try at the Question Box.

The Secretary read the following query:

"What is the Proper Size of Mesh in Coke Screens Through Which the Breeze Should Pass?"

Continuing, the Secretary said: I am not the author of the question, but as the matter of coke handling and crushing plants has concerned me not a little, I have been looking around to find an ideal system. In our part of the country it is my impression very little is being done, except in a limited way, with the crushing and screening of the coke by machinery. I thought perhaps this question might bring out some discussion as to the best arrangement of screens and number of sizes into which the coke should be divided, etc. I am sorry I have not any information to give upon it.

The President — This subject seems not to attract much attention. Evidently it is too soon after dinner. We will revert to it later. Perhaps we might better go on with the papers. I will ask Mr. H. N. Cheney, of Boston, Mass., to read his paper on

A Test of a Gas Engine Electric Lighting Plant.

The purpose of this paper is to describe the test of a gas engine electric lighting plant, made January 2d, 3d, 4th, 5th and 9th, 1901, at the Mechanics' Building, Boston. The plant was used for exhibition purposes, at a fair held last November at Mechanics' Building, Huntington avenue, where the engine still stands.

The test was made, at the request of Mr. W. R. Addicks, by a board of four, all connected with the Boston or Brookline Gas Light Companies. Mr. G. E. Whitney, of the Boston Company, was in general charge, and to him belongs all the credit for the successful carrying out of the experiment, and for the systematic and thorough manner in which the results were calculated and checked. Mr. P. H. Baker, of the Boston Company, was in charge of the chemical analyses, and Mr. P. C. Brown, of the electrical department of the Brookline Company, took charge of the electrical machinery and instruments.

The engine tested is rated at 20-horse power. It has two vertical cylinders with trunk pistons. The cranks are set at 180°, thus causing the working strokes of both pistons to come in the same revolution which is followed by a revolution with no working stroke. The cranks are inclosed and dip into oil at each stroke. The governor is of the missed admission type. The strength of mixture of gas and air is regulated by a screw which determines the lift of the check valve on the gas supply pipe. There are two valves to each cylinder—the exhaust valve, and the admission valve for gas and air—which both open once every two revolutions. One valve on each cylinder admits gas to the air supply pipe just in front of the main admission valve. Whether or not this valve opens depends on the position of the governor. The valves are operated from cams on a shaft running parallel to the crankshaft and at $\frac{1}{2}$ its speed. A starting lever is provided, which, when thrown down and locked, keeps the exhaust valve of 1 cylinder open during $\frac{1}{2}$ of the compression stroke,

and the exhaust valve of the other cylinder open continually. The engine is fitted with both electric and hot tube igniters. Both the sides and heads of the cylinders are water jacketed, the water entering at the bottom direct from the city main and flowing out of the cylinder heads, from whence it is led to the exhaust pipe a few feet in front of the exhaust muffler. From the bottom of the muffler the water flows to waste. During the experiment the piping was so arranged that a part of the jacket water could be turned into the exhaust pipe close to the exhaust valve. This was found to make the engine run with much less noise from the exhaust, and all the tests were made with the water flowing in this way.

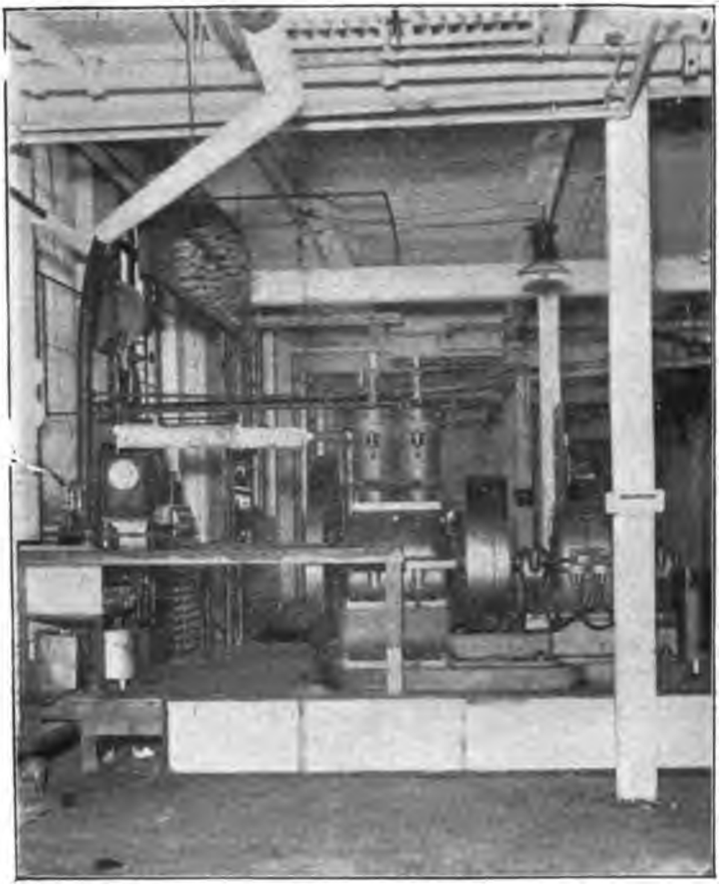
The engine is direct connected through a friction clutch, with a Lundell dynamo. It is a 6-pole machine, and is rated at 12.5 kw., 122 volts, 100 amperes at 280 revolutions per minute.

The friction clutch is intended to prevent the dynamo from following the engine too closely in the changes in speed which occur during each cycle. It consists of three leather covered shoes attached to the dynamo shaft, or, more properly, to a flywheel on the dynamo shaft, and bearing on the inner face of a pulley on the engine shaft. The shoes are pressed outward by springs, acting on them through levers which are prolonged in such a way that the centrifugal force in them tends to counteract the springs.

The load carried in the test was made up of 16 candle power, 110 volt incandescent lights, in the form of a sign and also in a bank, all controlled by suitable switches. The principal dimensions of the engine and dynamo are as follows:

Number of cylinders		2
Diameter of cylinders, inches		7.5
Length of stroke, inches		10
Clearance volumes, cubic inches	152.2	158.8
Campression, atmospheres (estimated)	6.75	6.5
Length of trunk piston, inches		15.25
Length of connecting rod, inches		25
Diameter of " " "		1.5
Crank pin, length, inches		3
" diameter, "		$3\frac{5}{8}$
Crank web, breadth, "		5
" thickness "		2
Crank shaft, diameter, inches		$3\frac{7}{16}$
" length of outside bearings, inches		6
" length of center bearings, "		5
" center to center of bearings, "		12.5


GAS ENGINE
PLANT.



Flywheel, diameter, feet	5
" width of face, inches	4.5
" thickness of rim, "	2
Friction clutch, diameter, feet	4
" width of face, inches	6.75
" thickness of rim, "	1
" shoes, number	3
" " length, inches	6
" " breadth, "	3
Dynamo flywheel, diameter, feet	4
" " width of face, inches	4
" " thickness of rim, inches	2.5
Armature shaft, diameter, inches	$2\frac{7}{8}$
" " length of bearings, inches	8
" " center to center of bearings, feet and inches	2.9
Cam shaft, diameter, inches	1.5
" gear, diameter, inches	16
" width of face, inches	1.75
" pinion, diameter, inches	.08
" " width of face, inches	1.75
Valve rods, diameter, inches	$\frac{5}{8}$
Bedplate, length, feet and inches	7 6
" greatest width, feet and inches	4 0
Extreme height of engine, "	6 8
" length of engine, "	8 2
" width of engine, "	5 0

The pipe connections to engine are as follows:

Gas	From service to meter, length, 35 feet	Size, 1.5 inch
	Meter	" 80 light
	Meter to engine, length, 21 feet	" 2 inch
	Gas bag, diameter of diaphragm, 18 in., depth, 6 in.	
	Supply pipe for hot tube igniter	Size, $\frac{1}{2}$ "
Air	From engine base to inlet chest, 4 feet	" 1.5 "
Water	All connections	" $\frac{3}{4}$ "
	Meter	" $\frac{1}{2}$ "
Exhaust	From engine to muffler, length 6 feet	" 2.5 "
	" 2 "	" 3 "
	From muffler " 105 "	" 3 "
	" 145 "	" 2.5 "

In fitting the plant for testing a wattmeter was set up to measure the output of the dynamo. The ammeter on the switchboard was tested and used. The voltage was measured with a portable volt measure. The gas meter and water meter were those which had been used with the engine. Thermometers were placed in the inlet to gas meter, and inlet to water meter, in the discharge from the jacket of each cylinder, and in the jacket water discharge pipe. A recording pressure gauge was placed at inlet to meter. A mercury gauge was

placed at the exhaust muffler. Revolution counters were attached to the engine, and to the dynamo, and counters were also attached to each gas inlet valve.

Five 6-hour tests of the plant were made at different loads. These loads were, nearly: Full load, three-quarter, half, one-quarter, and no load for the dynamo. The tests were conducted in the following manner. The engine was started with electric ignition and run with the load it was intended to carry throughout the test until the conditions became fairly constant. Then the test was commenced and readings of the various instruments taken every 10 minutes for 3 hours. At the end of this time the burners at the hot tube igniters were lighted and 10 minutes later a second 3-hour run was commenced, the electric igniters having been thrown out of service.

Several tests were also made of the regulation of the engine and dynamo. The load was suddenly changed by pulling out or throwing in switches. For three minutes before this change, and for 6 or 7 minutes after it, simultaneous readings were taken, at 1 minute intervals, of the voltmeter, ammeter, revolution counter on engine, and the revolution counter on dynamo. Principal results of the tests are shown in the following table:

LOAD.	FULL.		THREE QUARTER		HALF.	
KIND OF IGNITION.	Elec.	Tube.	Elec.	Tube.	Elec.	Tube.
Cubic feet gas per hour, 60° F	400.5	407.0	302.1	321.2	233.0	248 3
Temperature, inlet to meter	82.	82 82	75.	75.	71.	72.
Cubic feet water per hour	11.71	12.02	8.50	8.20	5.57	6.76
Cubic feet water per 1,000 feet gas	29.3	29.5	28.2	25.5	23.9	27.2
Cubic feet water raised 1° F. per 1,000 cubic feet gas	4,230.	4,460.	3,968.	4,110.	3,550.	3,810.
Temperature, jacket water, inlet	48.	48.	48.	49.	49.	49.
" " " discharge	192.	199.	189.	207.	198.	189.
Revolutions per minute, engine.	284.9	283.0	287.8	287.2	289.5	289.8
" " " dynamo	272.4	271.3	275.1	275.4	279.1	278.6
Gas inlets, per minute	280 0	278.7	215.1	230.9	191.7	177.6
Possible gas inlets, per minute	284.9	283.0	287.8	287.2	289.5	289.8
Volts	109.8	109.8	110.1	110.0	110.0	110.0
Amperes	101.2	101.0	76.0	76.0	51.0	51.1
Kw. (by meter)	11.4	11.4	8.4	8.5	5.6	5.6
Dynamo output in horse power	15.29	15.29	11.25	11.35	7.55	7.58
Efficiency of Dynamo	.831	.831	.821	.821	.787	.787
Dynamo input, in horse power	18.39	18.39	13.70	13.81	9.59	9 63
Kw. hours, per 1,000 cubic feet gas	28.5	27.9	27.8	26.4	24.2	22.8
Cubic feet gas per kw. hour	35.1	35.8	36.0	37 9	41.3	43.8
Dynamo input, horse power hours, per 1,000 cubic feet gas	46.0	45.1	45.4	43.0	41.2	38.8
Cubic feet gas per dynamo input, horse power hours	21.75	22.2	22.0	23.3	24.3	25.8
B. T. U. per cubic feet gas—						
Useful work	98.	96.	95.4	90.5	86.5	78.0
Dynamo loss	19.9	19.4	26.0	19.7	23.3	21.2
Jacket water	265.	278.	248.	252.	233.	238.
Calorific value	558 9	561.2	582.7	573.7	582.7	566 4
Percentage heat distribution—						
Useful work	17.5	17.1	16.3	15.7	14.8	13.8
Dynamo loss	3.6	3.5	3.5	3.4	4.0	3.7
Total dynamo input	21.1	20.6	19.8	19.1	18.8	17.5
Jacket water	47.3	49.6	42.6	43.9	38.2	42.1
Unaccounted for	36 1	29.8	37 6	37.0	43.0	40.4

Load — Kind of Ignition.	One Quarter — Elec.	Tube.	No Load — Elec.	Tube.
Cubic feet gas per hour, 60° F.	164.6	204.0	78.1	109.8
Temp. inlet to meter	73.0	73.0	73.0	71.0
Cubic feet water per hour	4.17	6.15	1.45	1.45
Cubic feet water per 1,000 feet gas	25.3	30.1	18.3	13.4
Cubic feet water raised 1° F., per 1,000 cubic feet gas	3,360	3,940	2,270	1,890
Temp. jacket water, inlet	49	49	58	57
" " discharge	182	181	182	200
Rev. per min., engine	290.7	290.2	292.6	290.9
" " dynamo	282.9	283.2	290.8	289.4
Gas inlet, per minute	137.8	167.4	50.9	62.4
Possible gas inlets, per minute	290.7	290 2	292.6	290.9
Volts	109.9	109.9		
Amperes	26.0	26.0		
Kw. (by meter)	2.7	2.8		
Dynamo output, in horse power	3.66	3.75		
Efficiency of dynamo	.681	.681		
Dynamo input, in horse power	5.37	5 51		
Kw. hours per 1,000 cubic feet gas	16 5	13.7		
Cubic feet gas per kw. hour	60.3	73.0		
Dynamo input, horse power hours, per 1,000 cubic feet gas	32.7	27.0		
Cubic feet gas per dynamo input, horse power hours	31.2	37.0		
B. T. U. per cubic foot gas—				
Useful work	56.8	47.1		
Dynamo loss	26.6	22.0		
Jacket water	210.0	247.0	144.0	119.0
Calorific value	577.0	588.0	576.4	567.1
Percentage heat distribution—				
Useful work	9.8	8.0		
Dynamo loss	4.6	3.8		
Total dynamo input	14.4	11.8		
Jacket water	36.4	42.0	24.7	20.9
Unaccounted for	49.2	46.2		

The cubic feet per kw. hour I have plotted against the load in kw. A glance at these curves show at once a considerable difference in economy with the different kinds of ignition. This difference is always in favor of the electric igniter. In making up the table and plotting the curves no account was taken of the gas used to heat the ignition tubes. This should not be charged to gas consumption, although it would appear in the gas bill. In comparing the two forms of igniter it should be set opposite to the cost of maintenance of the batteries, etc., for the electric igniter. The curves bring out very strongly the disadvantage of operating the plant at light load.

The great majority of gas engines at present are used for power purposes as distinguished from electric lighting. Therefore it seems worth while to plot the curves of gas per horse

power hour against horse power. The horse power in this case is the input to the dynamo which, owing to the loss in the friction clutch, is somewhat less than the output of the engine. The horse power is figured from the dynamo output by the use of the generator efficiencies furnished by the makers. These curves show practically the same things as the curves of cubic feet of gas per kw. hour, except that the consumption at full load holds more nearly for the other loads, owing to the different efficiencies of the dynamo.

In general the plant ran very well. No trouble was experienced in starting. No attention was necessary while running with the electrical ignition. With the hot tube ignition some slight attention was necessary. For some reason, perhaps late ignition and slow burning of the charge in cylinder, the mixture would sometimes become ignited as it was entering the cylinder and explode back into the base. This necessitated changing the strength of mixture.

In view of the difference between the results obtained, using electric ignition and those obtained using hot tube ignition, it is a pity that indicators could not have been put on the engine to determine the points of ignition. No good way was found to attach them, however, without danger of injuring the engine.

Now, in regard to the regulation of the engine and dynamo. Let us glance at the curves of revolutions per minute against load and kw. The revolutions of the engine decrease as the load increases. From one-quarter to full load there is a variation of about 6 revolutions per minute, or about 2 per cent. In the revolutions of the dynamo there is a much greater change. From one-quarter to full load it is about 11½ revolutions per minute, or about 4 per cent. Another curve which brings out the same thing, is one formed by plotting the slip, or difference between revolutions of the engine and revolutions of the dynamo, against the gas inlets per minute. This shows that the slip increases as the gas inlets per minute increase, or as the load increases.

From this it is seen that the friction clutch is in a certain way detrimental to the regulation of the voltage, since it permits the dynamo to vary in speed more than the engine does. It effects its purpose of preventing the dynamo from following the engine in the variations in speed which occur during a

cycle, but it does so at the expense of good voltage regulation under a varying load. I am told that this fault can be corrected by changing the winding of the dynamo field in such a way that the voltage will not rise with the increase of speed. The dynamo tested is especially wound with, I believe, this end in view, and it may be that, had it been run at its rated voltage of 122 instead of 110, the remedy would have proved successful. As it was, this special winding apparently did not improve matters very much, as the following results of the regulation tests show a change in voltage nearly proportional to the change in speed:

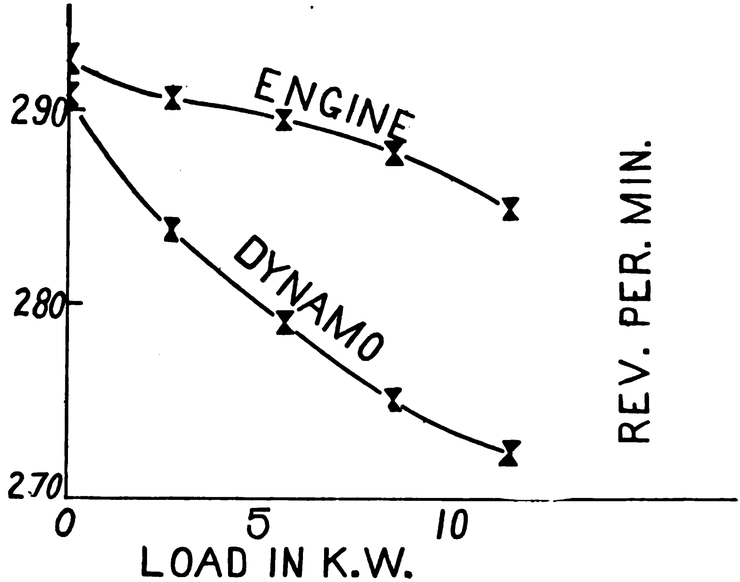
100 amperes......110 volts.		75 amperes......110 volts.	
changed to		changed to	
75 amperes......112½ volts.		100 amperes......108 volts.	
50 " 113½	"	50 " 111½	"
25 " 115	"	25 " 113	"
10 " 117	"	10 " 115	"
50 " 110	"	10 " 110	"
changed to		changed to	
100 amperes......107½ volts.		100 amperes......108 volts.	
75 " 108½	"	75 " 110	"
25 " 110½	"	50 " 111	"
10 " 111½	"	25 " 110	"

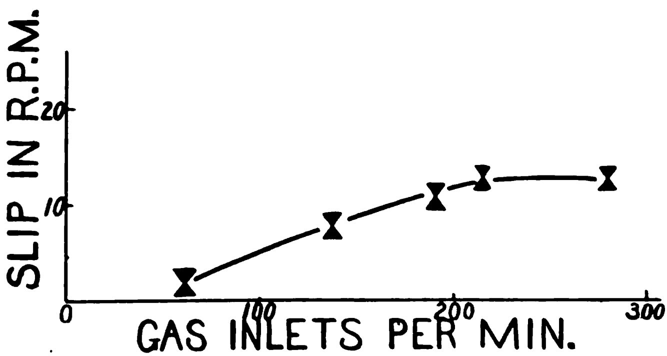
The cost of the plant is as follows:

Engine, including exhaust muffler, gas bag, batteries, spark coil	$1,050
Dynamo, specially wound, including rheostat . .	550
Switchboard and connections to dynamo, including 4 circuit switches, circuit breaker, voltmeter, ammeter lamps for each, 2-pole igniter switch, place for rheostat. made of 1 inch slate, price	150
Total cost	$1,750

The cost of installation, added to the cost of machinery, makes the total cost of the plant a little more that $2,000. From some figures the builder's agent was kind enough to show me, the cost of installation of the engine alone would average about $10 per horse power. Thus, if the engine were to be used for power, it might be installed for $1,250, though, ot course, that would depend largely on location. The interest and depreciation, a percentage of the first cost, make a cost which must be charged against the plant practically irrespective of the time of operation.

The greatest amount of water used in the jacket was 12 cubic feet per hour. If the engine were to be left without attendance this amount of water should be used continually in


ENGINE
DYNAMO
REV. PER. MIN.
290
280
270
0
5
10
LOAD IN K.W.


SLIP IN R.P.M.
20
10
0
100
200
300
GAS INLETS PER MIN.

case the load should be increased full load. The cost of water and the cost of oil, of which one quart was used in 13 hours, form a cost depending on the hours run.

Very little attendance is required by a gas engine when used for power. I recently had occasion to visit quite a number of gas engine users and to ask them, among other things, "Who tends the engine?" In a majority of cases the answer was, "No one, in particular." With the engine used to develop electricity for lighting it may require some little attention to keep the voltage constant, but this would depend upon the special conditions under which the plant was operated. Thus the cost of attendance may be practically constant, or may depend on the number of hours run, according as the engine is used for power, or for electric light with a varying load.

Now combining these three costs, the one for interest and depreciation, the one for water and oil, and the one for attendance, with the cost of gas used, which depends on the number of hours run and the load carried, it is possible to get the cost of operation per year or per horse power hour or in any other convenient form for any special case. The price of gas and water and the conditions of use vary so greatly that it is well nigh impossible to give any general figure that is of any value. It can only be said that, for stationary power service, the gas engine, with the operating expenses generally lower, possesses all the advantages of the electric motor, and for isolated electric lighting plants, up to 60 or 70-horse power, it has all the advantages that the steam engine has for larger ones.

Discussion.

The President — I know Mr. Cheney has a lot up his sleeve, and I think he can answer most of the questions fired at him. I will commence by asking Mr. Cheney one question. He said that at the varying powers the engine was run at, the constant voltage varied somewhat, and I would ask him whether, in going from full power to either three-quarter, half, or one-quarter power, he could observe any flicker in the lights, either going to the lower power or going from the lower power to the higher power.

Mr. Cheney — I don't remember any change in the lights.

The President — When you threw off, say half of the lights, you could not see it in the rest of the lights?

Mr. Cheney — I don't think so.

The President — Another thing referred to was the amount of water used. Of, course, this water was run to the sewer, because it was not convenient to rig up a tank. You are all aware that by the use of the tank we could save that water—12.2 feet I think he gave. Another thing I would like to call your attention to is the extraordinary length of the exhaust pipe, which I think was 250 to 260 feet.

Mr. Cheney — Two hundred and fifty-eight feet.

The President — A pressure guage put on the exhaust pipe showed the back pressure to be about 12 inches.

Mr. Cheney — Half an inch of mercury.

The President — Which would be 12 or 13 inches of water. As to the noise on the exhaust. If you had been outside the building where the exhaust pipe was laid you would not have been able to say whether it was a steam pump working or a gas engine. That may seem to you an exaggeration, but this is the truth of the situation. By the way, I want to say that I can arrange for that engine to be running, for any one who wants to look it over, between 5 and 6 this afternoon and between 9 and 9.30 tomorrow morning. Of course, we don't start it up if nobody wants to look at it, but if you want it, it will be started up.

Mr. Pratt — Does Mr. Cheney prefer the electric spark to the tube ignition on all sizes?

Mr. Cheney — The results from this engine seem to show that the electric igniter was very much more economical than the tube igniter. I am informed that other tests have been made with exactly opposite results, but I cannot say anything in regard to them.

Mr. Walton Clark — I cannot add anything of interest to Mr. Cheney's paper, referring to questions of economy, but it will be a matter, I think, of general interest to know that we are operating the electric apparatus and lights in our office building in Philadelphia with gas engines. Our building is [illegible] feet high from the curb. We have to pump water to the

top of the building for various purposes; we have three elevators to run and have numerous ventilating fans and electric lights. We have three 90-horse power gas engines in the basement, which engines are each coupled directly and rigidly to a dynamo. We have a storage battery, with a booster, for use in charging it. All the work in the building, including pumping water, running the elevators and ventilating the building, which requires considerable power, for we try to keep it thoroughly well ventilated, is done with electricity, and this electricity is generated, as I have said, by these three gas engines. We shut down the engines about 5 in the afternoon, I think, and the battery takes care of the load until the next morning or over Sunday. These are Westinghouse engines, 3 cylinder type. I regret that we have not yet made a complete test of our power appliances and machinery, for I had hoped to read a paper about it at this meeting. One of my sons had occasion this year to write a thesis, and in order that he might have opportunity of preparing himself I set up a gas engine at home, 3 horse power, belted to a $1\frac{1}{2}$ kilowatt dynamo, 120 volts, and he has made a very thorough test of it. I refer to that simply to remark on the beautiful governing of the engine. Starting with one-quarter horse power load on a brake, and running from that to all the engine would turn over, the variation in revolutions was only from 259 to 261, and there was no perceptible change in the lights with any of the variations in load when the dynamo was connected. That was a White & Middleton engine, and I don't know that it had any frills on it. We bought it in the market; and it certainly governs very closely, and is perfectly adapted to use for electric lights. All the power used in our office building comes in through two 4-inch gas service pipes. We had at first certain troubles with the gas engines. One or two cylinders were broken; but we had ample reserve; and I believe everything now runs perfectly smooth. We expect to see a very considerable introduction of gas engines for generating electric power in office buildings in the future. I want to say in this connection that our engine room is 15 or 20° cooler in hot weather in the summer than any other engine room of the same size in any office building that we know of, which is quite a point.

The President — That last fact is a very important point.

Of course, it is not quite so cool as when you buy your electric light from the central station, but I don't suppose Mr. Clark intimates that.

Mr. Egner — In my recent travels I met a gas man who met electric competition and made a customer for gas in this way. His name is Mr. Walter Thomas, and he is Superintendent of the Vancouver Gas Company. An electric lighting company that was organized there, with a very fine plant indeed, bought the Welsbach patents, so I am informed. If a customer of the Gas Company wanted a Welsbach mantle lamp he could get one by paying $5 for it, and they would rent it to him if he would pay $3 a year. So Mr. Thomas could not beat the electric light at all with the Welsbach mantle. They tried to, but the Gas Company was sued and was fined altogether $2,000 damages, which experience ended that trial. So Mr. Thomas studied electricity and studied the gas engine. He imported gas engines and house dynamos, and hooked them up. He showed me the results. I went with him to machine shops and foundries where the gas engine had displaced the electric motors. At night time I went round with him to a number of public resorts where they often had as few as 30 incandescent electric lights up to quite a number more. He interviewed those people, and in the end would put a gas engine in the cellar to operate a little dynamo, with a small switchboard, and furnished them light. His day consumption, by the gas engines especially, was larger than his night consumption, and his summer consumption was as large as his winter consumption. When I asked, "Who takes care of the engine?" the answer was very much like that in the paper, "Anybody," but the people generally who owned or ran the places spoke in high praise of the engine. I was told how economical it was, and how much it saved in lighting bills. In that way Mr. Thomas hit the electric company very hard. He is a very energetic young man. He said every gas engine introduced sold another. He had four or five standing there. He asked me what I thought of it. I said, "Thomas, I think you are working yourself out of a job." He said, "What do you mean?" and I answered, "The electric company will be buying up the gas works, and they may put you out." "Well," he said, "That is what they are trying to do now."

Mr. W. F. Humphreys — Was that exhaust pipe used for heating? Why was that distance of exhaust pipe run?

Mr. Cheney — The engine was situated in the Mechanics' Building on the Huntington avenue side. The city officials are very particular not to have any exhaust on Huntington avenue, so it had to be carried to the back of the building. That explains the cause of its length.

Mr. F. W. Humphreys — Have you encountered any factories or places where they had been using the exhaust for heating at all?

Mr. Cheney — No.

Mr. F. W. Humphreys — For heating part of the building, or anything of that kind?

Mr. Cheney — No.

Mr. Walton Clark — Mr. President, the exhaust from our gas engines is used for heating.

The President — It is on the first and second floor, is it not?

Mr. Walton Clark — It produces heat for the first floor, the main offices.

The President — Did you use cast iron pipe for an exhaust, do you remember?

Mr. Walton Clark — No; we did not. I don't understand the clutch between the gas engine and the dynamo in the case reported by Mr. Cheney.

The President — Will Mr. Cheney explain that in greater detail?

Mr. Cheney — (Indicating on the plan.) Between the engine and the dynamo is this pulley on the engine shaft, and this pulley right side of it on the dynamo shaft, and connected to the spokes of this flywheel on the dynamo shaft are 3 shoes that bear on the inside face of this pulley on the engine shaft and which slip around on the inside. They are held out by springs attached to the hub. The fulcrums of the levers that act on the shoes are on the arms of the flywheel.

Mr. Norris — Are these shoes suppose to slip when the engine takes a charge?

Mr. Cheney — Yes, sir.

Mr. Norris — Rather an unmechanical sort of device, it would seem at first sight.

Mr. Walton Clark — Was that a satisfactory arrangement?

Mr. Cheney — As I said in the paper the dynamo speed varied more than the engine speed.

Mr. Walton Clark — Then it was not a satisfactory arrangement?

Mr. Cheney — In some ways, yes; in others, no.

Mr. Walton Clark — When we were thinking of installing these gas engines one firm of engine builders proposed to put in a flexible shaft, not to provide for any slip, but so that any jump of the engine would put this shaft under greater tension. We did not adopt that finally. Our dynamo was connected rigidly.

Mr. Cheney — I would say that this friction clutch was tightened, so that the slip was reduced, I think, to 5 or 6 revolutions per minute. At full load there was then quite a perceptible variation of the voltage as the engine took gas.

The President — I would like to read from a test that Mr. Cheney has not given; that is to say, the test on a particular day. This is the result of 10 minute readings on each hour of the test, for 6 hours. The revolution of the engine per minute for the first hour, 285.8; next hour, 285.1; next hour, 285.1; next hour, 284.8; next hour, 284.6; next hour, 284.9. The revolutions of the dynamo per minute for the first hour, 273.0; next hour, 272.4; next hour, 272.5; next hour, 272.1; next hour, 271.8; next hour, 272.4. You see the slip between the engine and the dynamo was practically constant, running at constant speed. Now, taking another day—

Mr. Walton Clark — I was going to say that apparently the average per hour was constant, but the question is how is it from second to second, and from half-minute to half-minute?

The President — That will be shown to some extent by the voltmeter if I read the voltmeter. Mr. Cheney, at a full load run, what was the maximum variation in the voltmeter from minute to minute, during the full load run, in changing the load?

Mr. Cheney — I should not say there was any variation perceptible from minute to minute. As the lamps became warm more and more and the circuit became warm there was a slight difference, but the voltmeter was absolutely steady.

The President — Does that answer Mr. Clark's question?

As a matter of fact, I personally examined the voltmeter needle and could scarcely see any variation. Half a volt was the maximum variation that I could see, I think, in 10 minutes.

Mr. Walton Clark — A considerable variation was reported when the load varied.

The President — Exactly. That was on a test of dropping from full load quickly, instantaneously, down to quarter load, or half load, as an extraordinary test, to see if we could notice any change in the lamps in that drop.

Mr. Walton Clark — The question in my mind is as to the efficiency of that clutch. It does not seem to me quite right. I think this is one of the most important subjects that we could discuss, and if there are any more points that can be brought out, Mr. President, I hope the question won't be dropped now. We have electricians here who should be able to give us considerable criticism of this paper.

Capt. White — Did Mr. Clark use the storage battery in Philadelphia as a means of regulating the current of the box, or just to take care of the load?

Mr. Walton Clark — The storage battery which is on what we call a spur connection was put in to take care of the night load and Sunday load. I don't mean to say that perhaps we would not need it anyway, for it certainly does govern to some extent; but our purpose in putting it in was to enable us to run the engine 10 hours a day and shut down for the rest of the day.

The President — If we keep the discussion up long enough on this line perhaps some people would like to go out and look at the gas engine. We might get their interest up to wonder what it is. As there seems to be no desire to continue the discussion further, I extend to Mr. Cheney, on behalf of the Association, its thanks for his paper and for the care with which he has looked up the subject. Our members will, I am sure enjoy looking over the data later on, which inspection will answer many of the questions asked that were possibly not fully replied to. We will now revert to the Question Box and try the query that failed of answer half an hour ago.

The Secretary —

"What is the Proper Size of Mesh in Coke Screens Through Which the Breeze Should Pass?"

Presumably, when the coke is crushed and passing from the

crusher to the sorting of the different sizes of broken coke for sale.

Mr. Coggeshall — The size of our mesh is ½ inch.

The Secretary — Does Mr. Coggeshall divide the broken coke into more than one size?

Mr. Coggeshall — Apparently what we sell is all one size. It will vary some.

The Secretary — Yes; but you do not make several kinds of coke; say, pea or nut or stove coke?

Mr. Coggeshall — No.

The Secretary — The next question is:

"In Coal Gas Manufacture, does it Pay to Work for Highest Yield, or Should Greatest Number of Candle-feet be Sought for?"

The President — That should be an easy one.

Mr. Walton Clark — Suppose you try it, Mr. President.

The President — Mr. Clark, I am making coal gas just now.

Capt. White — Much depends on whether or not you have Welsbach burners. To give the question a sort of send-off, Mr. President, I might say this matter is largely local in its application. The question before us could be settled did we know whether one was selling gas to a community burning its gas in ordinary burners, or using Welsbach or other burners of the incandescent type. It is well known there is more money for a gas company to make and sell a low candle power coal gas to people who will use the Welsbach type of burner than there is in attempting to make a high candle power of coal gas for sale through the ordinary burner. The answer to the question simply resolves itself into the questions of locality and as to what is going on therein. A man who is urging the sale of Welsbach burners is simply wasting his stockholders' money in attempting to make a 20 or 25 power candle gas. Gas after all in our day is resolving itself into a question of heat units, not illuminating power, and where a man is earnestly endeavoring to give the best results to his community with the least expense to his directors, he comes to the question of the amount of gas that he can put into his town at the lowest candle power and still give his users high illumination, the people getting that illumination through

the auxiliary work of incandescent lamps. It is impossible to make a law that will apply to everybody. You simply say it is a question of locality, just exactly as it is a question of locality whether a man will build a coal or a water gas works, or whether he will have a works combining both. It is largely a question of the cost of material and of labor and of conditions at that point. In this case an answer to the question becomes purely a thought as to whether he can make a cheap coal gas of low illuminating power and send it out to a community that is using largely the Welsbach lamp or a burner of that type—I simply use that as a type. I don't see how we can offer to the questioner any other answer.

Mr. Norris — I think that by assuming certain average conditions we can perhaps answer the question a little more definitely than Captain White has indicated. While sitting here I have been doing a little figuring, and have assumed as fairly representative of ordinary practice the following data: Oil at 4 cents per gallon; gas coal at $3.50 per net ton, delivered in sheds; labor, $1; residual receipts, $2.50 per net ton of coal carbonized. I have also assumed a works making a 20 candle power mixed gas, using water gas as an enricher, and that a variation in candle power of coal gas simply means the use of more or less oil in the water gas sets without affecting other costs. In speaking of candle power I assume the use of a flat-flame burner. Under the above conditions I have endeavored to figure the effect on the cost of the mixed gas of a high yield of low candle power coal gas, as compared with a lower yield of higher candle power gas, the total number of candle feet per pound being the same in the two cases. I have, therefore, taken 5 feet of 14 candle power gas, or 70 flat candle feet per pound, and compared it with 4½ feet of 5½ candle power gas, which also figures 70 flat candle feet per pound, and enriched both gases to 20 candle power by using more or less oil in the water gas sets. Under these conditions I find a difference of about 2 cents per 1,000 in the cost of the enriched gas, in favor of the higher yield per pound with the lower candle power coal gas. In other words, where the deficiency in candle power can be made up by using extra oil in the water gas sets, the most economical result is obtained with a high yield of gas per pound, even though the candle power of the gas be reduced in proportion. To put it another way,

with equal candle feet per pound of coal the higer the yield per pound the cheaper will be the mixed gas in the holder.

Mr. Egner — The question that has been put is quite a deep one. In fact it strikes me it would be a good subject for a very good paper, for in the question whether it is best to make the greatest number of candle feet or to get a high yield, a great many things enter that a practical gas man must know. I know of works where, for instance, they have, as near as I can remember, 10 or 12 men working on the retort house floor, with a like number cleaning the chokes in the pipes. There is little economy in that. I don't want to take up your time calling attention to these practical facts, but the question itself can't be answered off hand. As I said, it is a question with matter in it for a very good paper by some able man.

Mr. Norris — I figure that under normal conditions, with hand-fired benches, and with any given number of candle feet per pound of coal, a difference in yield of one-tenth of a cubic foot of gas per pound makes a difference of about one-half a cent in the cost of the gas per 1,000.

Mr. Egner — If the same number of men will do the work, of course, if you have not stopped stand pipes and other difficulties to contend with which are bound to come.

The President — Mr. Egner, the question I think has been limited to 5 feet to the pound. Mr. Norris limited it to 5 feet to the pound in his presentation, I think.

Mr. Norris — No.

The President — In your calculations you took 5 feet of gas to the pound as one limit, and 4½ feet as the other.

Mr. Norris — In my last figures I assumed the cost for labor and the yield of residuals per ton of coal carbonized remained constant, and the only variation was in the yield of gas per ton.

Mr. Coggeshall — There is too much supposition in relation to communities using gas, especially in New England, with which we are connected. We don't find any communities to whom we are supplying gas that are using all Welsbach burners. If we should send out gas of 15 candle power there would quickly be a howling round our ears. A few years ago there was a great ambition among the gas engineers to produce a large quantity of gas per pound of coal. Some of them, I

think, read papers in which they showed yields of 5.41 to 5.60. Being ambitious to meet the best results I ran mine up very high, but soon found my hydraulic main filled with pitch and the standpipes stopped. About 10 years ago I dropped down to about 5 feet to the pound, and I have since figured as near to that as I could and have had very little trouble from stoppages since.

The President — I think we had better couple on to this question another relative question, which appears later on in the list. It is:

"Is the Incandescent Gas Burner in Sufficiently General use to Warrant Going Back to the Gas of 17 Candle Power?"

It is intimately connected with the question as Capt. White presented it.

Capt. White — Mr. President, I may also be pardoned for repeating myself, but I have given it as my opinion, at the various meetings of the Gas Associations, that we were all making a very great mistake in training our public to these high illuminating powers, in the face of the development of incandescent lighting, and I have persistently urged that after all some man inspired by the necessities of the business, as is always the case, would yet develop how we might make great volumes of coal gas of accepted heat values in cupolas, much as we make water gas today; in other words, that one man instead of making a few thousand feet per day would make hundreds of thousand feet, and that this gas would not exceed 15 or 16 candle power, but it would possess all the heat values of straight coal gas. Now, I believe that, with the continually increasing competition of the electric light, the development of the electrical engineer in his field, and the consequent development of the mechanical side of the question of electric light—and you will all agree with me—that when it becomes a pure question of mechanics, which it is today, the American mechanic will develop and settle the question of how to obtain the greatest electrical values at the least expense. Now, as the slang of the day has it, "We are up against it." The electrical engineer is winning his spurs, also his way. The gas engineer must meet him. I believe, as I have for some years, that the developments to come in the gas industry will

not be along the line of water gas or in some newly discovered process, but along the line of how to best apply what we know in the coal gas industry, how we can get the most out of a ton of coal of the greatest heat values. For, gentlemen, it is all developing itself right back as to how to get the most heat value out of the coal. And every man in this room will live to see the sale to the public, not of cubic feet, but of heat value, in some form—in units, if you please, simply for a term. And, therefore, I also look for the development of the man who will furnish us an incandescent gas lamp, not in the present expensive form of the Welsbach and such type of lamps, but somebody who will give us an incandescent bulb that may be dropped over the ordinary burner, with some little arrangement for the introduction of air, which will be so very cheap that the ordinary householder can buy it at some simple price. Then we can send into the streets a 15 or 16 candle power coal gas that will give the people who don't wish to use the incandescent lamp a really good light, but those who want higher illuminating values will have a cheap means of securing this greater light value from the gas. I believe, gentlemen, that we will all be selling gas at one price, for all purposes, through one service and measured by one meter, within very few years. The development of the business compels it. And, therefore, I come back, Mr. President, in answering the question which you have coupled on to the preceding one, to my first position, that it is, after all, a local question in the one case and a development of the incandescent burner in another; and I firmly believe that every man here will live to see the development of just what I have said—the production of coal gas in great quantities through cupolas, one man producing as much coal gas practically as is now produced of water gas by the same means, that one meter and one service and one general price will answer all the purposes of the public. When we canvass our public for the use of gas it will be simply at one price; they may use it in stores or they may use it in dwellings. The answer to the question simply is founded upon the fact that, through the incandescent lamp, the result of the discoveries of Dr. Auer von Welsbach, which are illuminating the pathway for men who shall follow him, through the demand which the electrical engineers will force upon us, the gas engineer will develop a means of making a 15 or 16

candle coal gas at so cheap a price that it may be sold for all lighting and fuel purposes at a price at which your public will not care to use coal with its many annoying features.

Mr. F. C. Sherman — I would like to ask you what proportion of the burners in this city today are of the incandescent type.

The President — I cannot answer that question, Mr. Sherman. I endeavored to find out at the Gas Appliance Exchange how many they sent out a month, and could not get any definite information as to the city proper. From memory it was something over 1,000 a month, I don't remember just how many. Now, I would take what Capt. White has said from my point of view, something on my musing of last year. Personally I don't believe that we have reached a point when we can go to low candle power. In the first place, in this State we could not go below 16 candle power in any case—a few years ago we could have gone to 15 candle power; but I think we have to give everyone a light that he can use in a straight burner, and one that will be satisfactory to him. If you have a higher candle power gas it is apt to be a gas of higher heat units, and, therefore, he will not use as much in his Welsbach burner, in his gas engine or in his gas stove. I personally don't believe that the day of lower candle power is with us. I would qualify that in this way: It depends upon the quality of the gas whether the candle power is high or low. If it is a mixture of water gas and coal gas I would call a 25-candle power a very high candle power. So that it depends, somewhat. As to a straight coal gas, I would consider 18 candles a very good, in fact a comparatively high candle power, not exceeding 19; and in a water gas, where you don't attempt to free the gas from carbonic acid, I think that 25-candle power is about the right thing. That is my personal opinion. I know of cases in gas engines, where the very fact of being water gas, not taking the carbonic acid out, is the reason why they kept that gas in service, because the heat units were higher. Of course, we cannot go so far, that the carbonating material would be so great as to cause dirt on the valve. Returning to the question that Mr. Clark asked me to answer in the first place, given the practical question, the maximum yield of gas that will prevent practical difficulties I think is the yield that you ought to get from your gas. I don't

think you ought to melt down your arches, I don't think you ought to stop up your standpipes and fill your hydraulic mains with pitch, but I would go to a point where you would just avoid all those difficulties. However, someone might fill up a standpipe with pitch because it was too small a standpipe, so the practical question comes in there, that one would have to investigate whether he has the best standpipe for the condition under which he is working.

Mr. F. C. Sherman — Not over one-third of our customers in New Haven use the incandescent light. The other two-thirds would be out, if we were only making a 15 candle gas.

Mr. Walton Clark — Mr. Sherman, how much pressure do you carry on your street mains?

Mr. F. C. Sherman — The maximum is $3\frac{1}{2}$ inches; the minimum is 2 inches.

The President — Mr. Sherman, I think the Welsbach burner is the rule as far as the shops are concerned; but in houses I don't think that follows.

The President then introduced Mr. J. J. Humphreys, Jr., of Worcester, Mass., who read the following paper on

Some Sketches of Gas Governors.

Samuel Clegg's patent of December 9th, 1815, for an "Improved gas apparatus," which was the first English patent for the wet meter (or any other), also covered a self-acting governor for regulating the discharge of gas through any opening.

The governor consisted of a short pipe, with a vertical partition, dipping into a cup of mercury. The inlet and outlet of the governor were on opposite sides of the partition, which had a hole through it, more or less closed, according to the position of the mercury cup. The mercury cup was carried on one end of a beam, which was actuated by a counter-poised, small gasometer, operated by the governor outlet pressure. This governor was said to be intended to reduce the effect of the meter pulsations.

In 1817 James West patented a governor, "Which may consist of a closed vessel, in which is placed a small gasometer, the elevation of which by pressure of gas elevates a flat circular plate or valve, and brings it more or less into contact with the mouth of the entrance gas pipe." Presumably, this is the governor mentioned in Richard's "Treatise on Coal gas," as

having been described in Accum's "Treatise," published in 1819.

The first street main governor seems to have been that of William Pontifex, the younger, which was a small gasometer, counterpoised by chains, a lever and a weight, operating a sluice or valve fitting into the main.

In 1825 Samuel Crosley patented the governor with diaphragm. The diaphragm carried a suspended plug valve.

Hugh Ford Bacon was well ahead of his time when, in 1839, he patented a diaphragm governor, with spiral spring or lever and weight adjustment and two conical valves, which are balanced by the one opening inward and the other outward.

John Parkinson claims about the same thing in his patent of December, 1853.

During the 50's and early 60's there seems to have been an awakening to the advantages of uniform pressure, and many patents were issued, of which the following were the most notable:

1853.—Moses Poole claims patent on governors set tandem.

1856.—Luther Young claims application of mercury in hollow balance lever, to change balance of governor float.

1856.—David Dick claims as governor valve a beveled or notched inlet pipe dipping into a mercury seal.

1857.—John Sudbury and Alfred Linsel claim as governor valve a diaphragm actuated piston, working in cylinder, perforated with several triangular holes.

In 1858 there were even patented as governors, fibrous masses, more or less compressed according to pressure of gas, perforated plates, cloth, and shot or seeds for checking the gas. This sounds quite like the descriptions of the governors now peddled by fakirs.

1858.—W. H. Bennett claims governor operated by small pipe from distant low pressure district, which principle was used, according to the 5th edition of "Clegg," in the Servier governor at Paris.

1859.—Rodier claims application of the increase of pressure by governor float picking up chain, each link adding to weight of float.

1861.—Henry Giraud claims pressure gauge to make electric connection at distant point, and operate by water pressure a valve at the works.

1865.—John Keeling patented his water loading pressure changer, and built a 36-inch governor on this principle for one of the London gas companies. The patent said nothing about the arrangement being automatic, claiming only that it was less abrupt than changing solid weights; but at certain adjustments it was automatic. This was the first of the water loading governors.

Richard's "Treatise," 1877, shows a governor by the Messrs. Braddock, in which the effect of the gas pressing downward on the valve is counterbalanced by the pressure of the gas from the inlet pressing upward in a chamber of the bell, which has the same area as the valve. This principle is shown also in the drawing of the Cowan governor with this paper.

Originally, the gas passing street main governors all went through the bell, but after an accident to one of the governors of a London works, various plans were devised to prevent any large amount of gas from being set free by an accident to the governor bell.

Of the compensators the earliest and simplest was the damper valve in the exhauster bye-pass pipe, operating by a floating bell. The Smith and Sayre compensator, shown by a drawing, has been the one principally used in this country.

The two types of exhauster governors shown with this paper are the Isbell and the Root, the latter serving as a type of the various governors adapting the principles of the Huntoon governor.

So much can be said of the street main governors that it is best to say little. The small works using a holder throwing about 27-tenths on the town at all times has the best of governors. Next in value comes a good street main governor, which is surely better than man, who is always fallible. A recent article in the London *Journal of Gas Lighting*, describing the new gas works at Zurich, spoke of three governors being installed. On the main line were two governors set tandem, the first feeding to the second, or automatic governor at a constant pressure, no matter what holder was in use, or how many sections uncupped, so that the pressure at the outlet of the automatic governor would be affected only by the amount of gas passing. The third governor was on a branch pipe, and would operate to supply the town only when the other pair failed.

Care of the street governors plays a large part in their successful use. Thorough half yearly cleanings, monthly oilings, weekly examination of water line, and daily inspection as to sticking (from naphthaline, etc.), will make any half decent street governor do its duty faithfully.

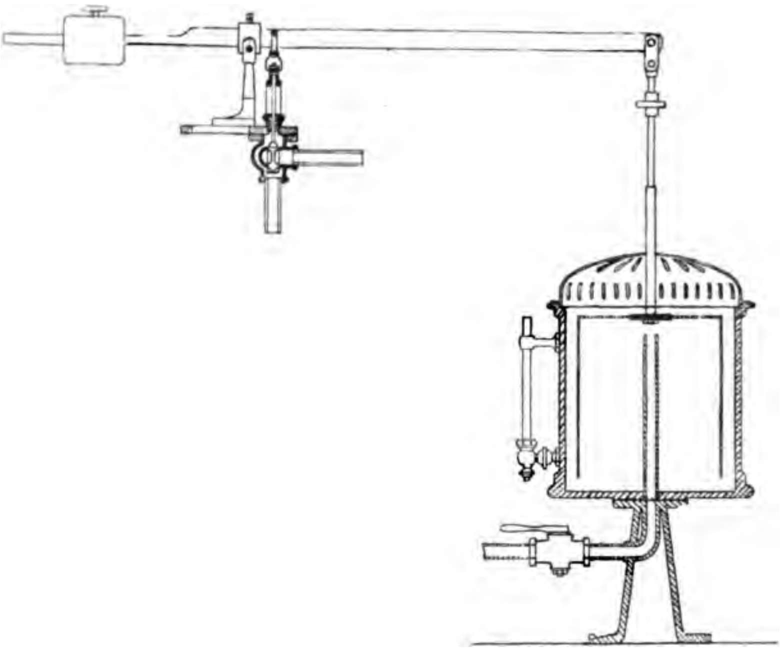
While New England has not yet reached the point of installing high pressure gas, we are all interested in it, and I have shown three types of natural gas governors and the Pintsch governor for compressed gas. I am informed that the best practice demands from 3 to 4 reductions in natural gas pressure from the well to the burner; the high pressure governor reducing from the well to the line pressure, the low pressure governor reducing to 20 or 30 pounds at the city line, the house regulator reducing to 4 ounces, and if there are any Welsbach burners used, a governor reducing to about 1 ounce. All the natural gas governors looked up, except those for the illuminating line, have safety valves, blowing off into the open air in case of trouble, and most of the governors are to be had with either spring or weight and lever adjustment. All the house regulators had automatic valves, which closed in case of failure of supply, and would not again pass gas until started by hand.

No. 1. The Isbell Exhauster Governor.—A small float and weighted lever operates a balanced piston valve, supplying exhauster engine with steam. Exhauster pulsations in float reduced by throttling gas supply of float.

No. 2. Root's Improved Gas Exhauster Governor.—A refined Huntoon with a very similar steam valve placed vertically. The float has a bottom with only $\frac{1}{16}$-inch clearance all around the inlet pipe for the water to work through. This aids in reducing the exhauster pulsations in bell, which are also guarded against by the spring connection, and by throttling the gas supply to float.

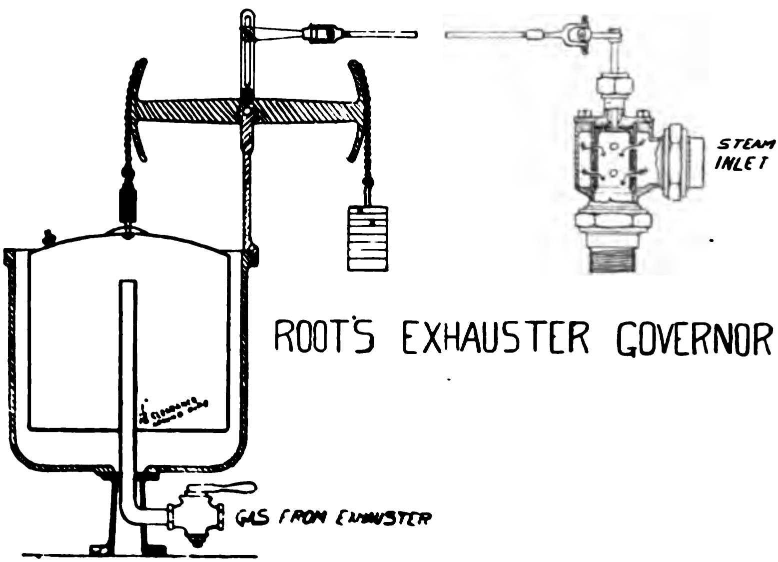
No. 3 The Helme "Rocker" Exhauster Governor.—The gas from outlet of the exhauster enters the closed side of tank, increasing or decreasing the space above water line, and thus turning the tank and operating the steam valve on exhauster engine. The flow of water is retarded by the diaphragm plate at the bottom.

No. 4. Isbell-Porter Compensator.—A simple balanced valve governor on exhauster bye-pass, opening to pass part of the gas



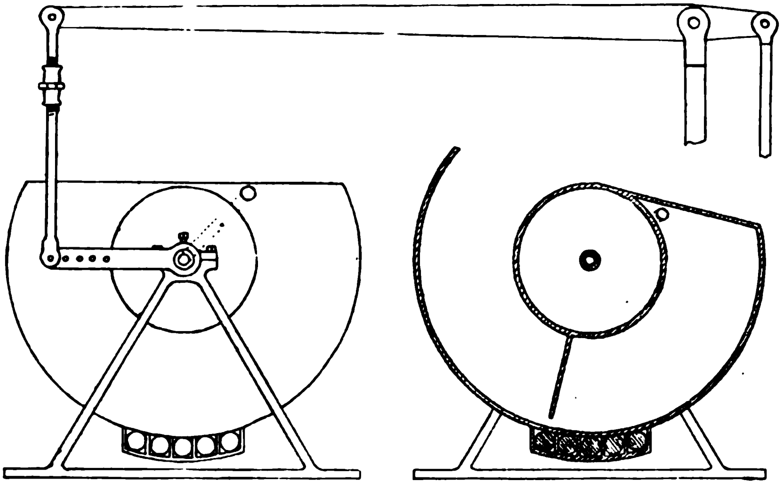
ISBELL EXHAUSTER GOVERNOR

No. 1



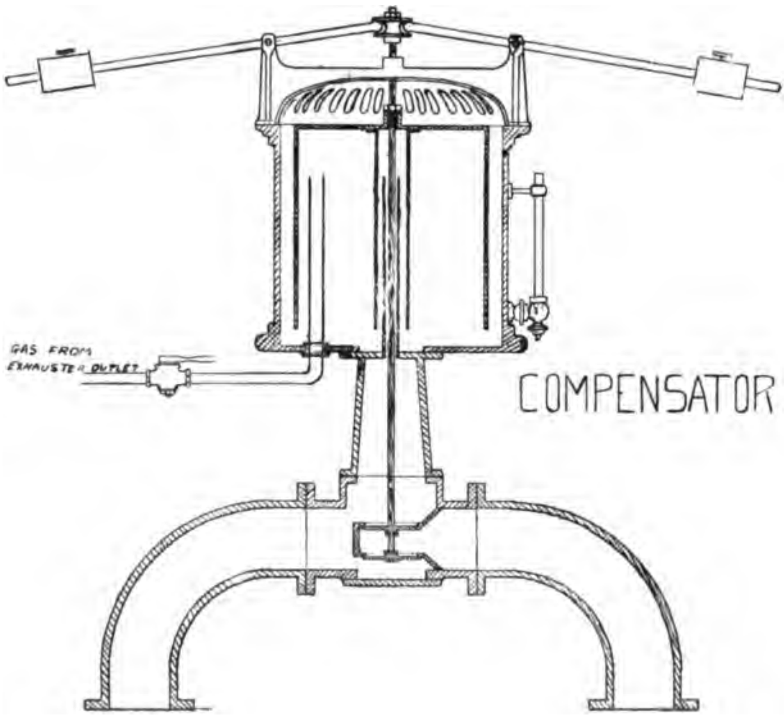
ROOT'S EXHAUSTER GOVERNOR

No. 2



HELMES ROCKER GOV. FOR EXHAUSTERS

No. 3

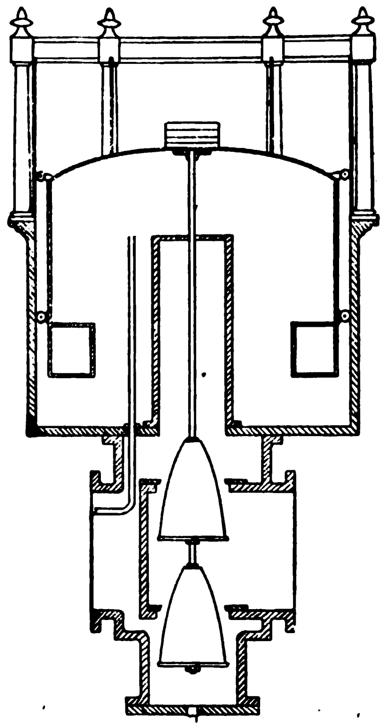


No. 4

back when there is too much pull on the inlet side of exhauster.

No. 5. Parkinson's Equilibrium Governor.—The large float with small gas passage to it and simple balanced valve, make the governor very steady in its action.

No. 6. Braddock's Balance Governor.—This governor is also made with automatic water loading attachment, in which

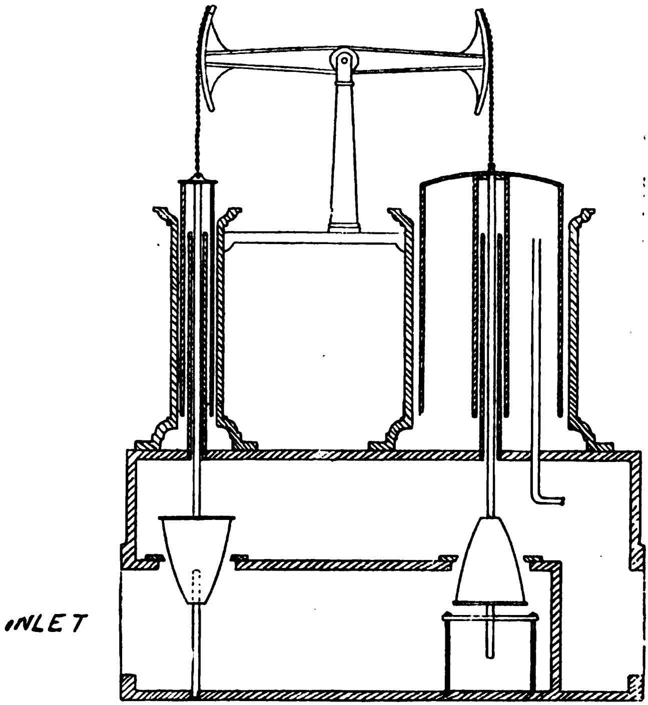


PARKINSON'S EQUILIBRIUM GOVERNOR.
No. 5

a tank on top of the governor float connects by a rubber tube with a tank carried by another float, the raising or lowering of which by the outlet pressure of the governor loads or unloads the governor float. The tank on the loading float maintains its water level by a ball-cock and an overflow.

No. 7. The Foulis Underground Gas Governor.—In this governor the float is also the valve, and is operated from the

separate pressure vessel placed not more than one-half mile away. Loading the pressure vessel increases the pressure under the governor float, with which it is connected by an air pipe. The governor is steadied in its action by the plunger, which works on the anti door-slammer principle. The plunger



BRADDOCK STATION GOVERNOR

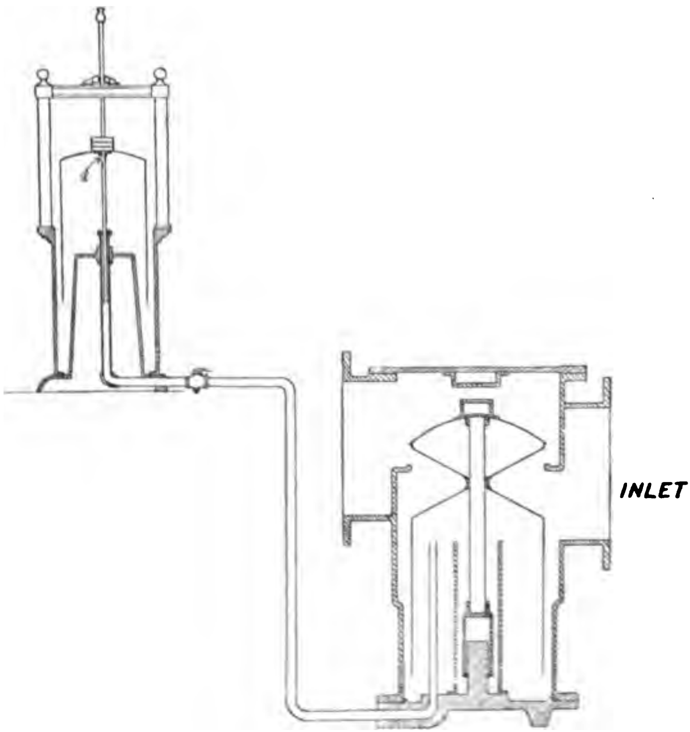
No. 6

and portions of the float (not shown in drawing), across the valve opening, act as guides.

No. 8 Isbell-Porter Standard Street Main Governor.—The weight of valve and float is supported by a submerged air chamber, which can be loaded with water to give the minimum pressure, the weights being used only for increase of pressure. The upright edges of the balanced valve are notched to make

the governor sensitive. These valve edges and the arbor on top of governor act as guides for the valve stem.

No. 9. The "Milwaukee" Damper Gas Governor.—This governor has a vertical damper, operated by gearing from the balance arm supporting the float. This governor is in use at Milwaukee and at Racine.



FOULIS UNDERGROUND GOVERNOR

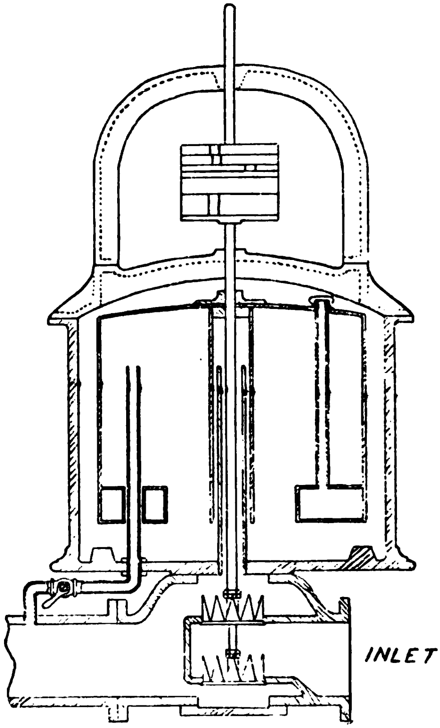
No. 7

No. 10. Keeling's Pressure Changer on Wright's Governor. —The outer water tank can be raised by hand windlass to discharge into loading tank, or can be set at such position that the movement of the balance arm will do the loading or unloading.

No. 11. Mercury Arm Governor.—The hollow arm contains mercury, which flows to the inner end to increase the pressure

when the float has lowered sufficiently, the action being reversed when the float rises.

No. 12. Isbell's Roller Weight Governor.—The pressure was changed by the rolling in or out of the weight, according to the inclination of the tracks.



ISBELL-PORTER GOVERNOR

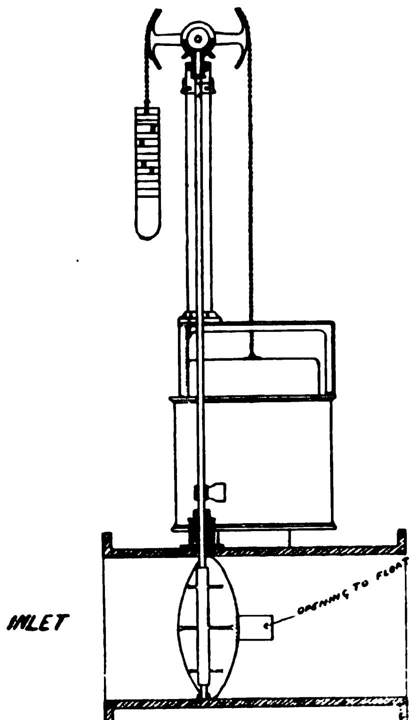
No. 8

No. 13. The Servier Governor.—The float was acted on by the outlet pressure at the governor, and also through a small pipe by the pressure in the low pressure district.

No. 14. The Milne Governor.—A weight suspended from a helix puts more or less weight on the bell as it rises or falls, according to the varying distances of the suspended weight from the center of shaft.

No. 15. The Hopper Automatic Governor.—As the float sinks with the opening of the valve, the area of float at the water line decreases, thus throwing a higher pressure.

No. 16. The O'Connor-Milne Governor.—As the bell sinks, two siphons transfer water from the tank in which the bell



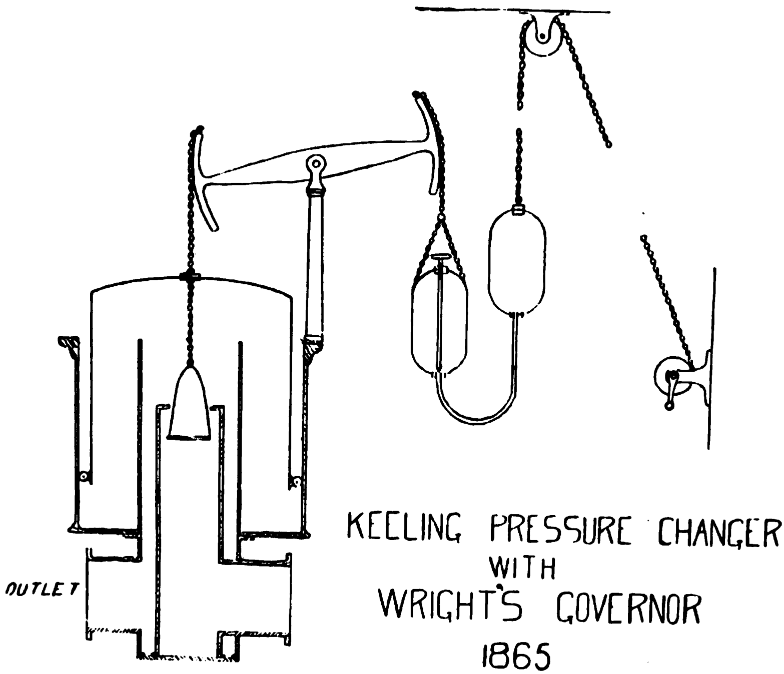
"MILWAUKEE" GOVERNOR

No. 9

floats to a water tank carried in the center of the bell, increasing the pressure.

No. 17. Cowan's Electrically Operated Governor.—A small pressure vessel in the distant low pressure district makes connection with the loading or unloading wire as the pressure rises or falls. The weak line current operates a relay at the governor station, which allows a stronger current to pass

through the magnet, opening the loading or unloading valve. To avoid variable or excessive water pressure, the water for loading is taken from a tank giving about 10 feet head. The tank is supplied by a ball-cock. The pressure on the governor gas valve is balanced by the downward pressure in a compartment of the same area as the valve.



No. 10

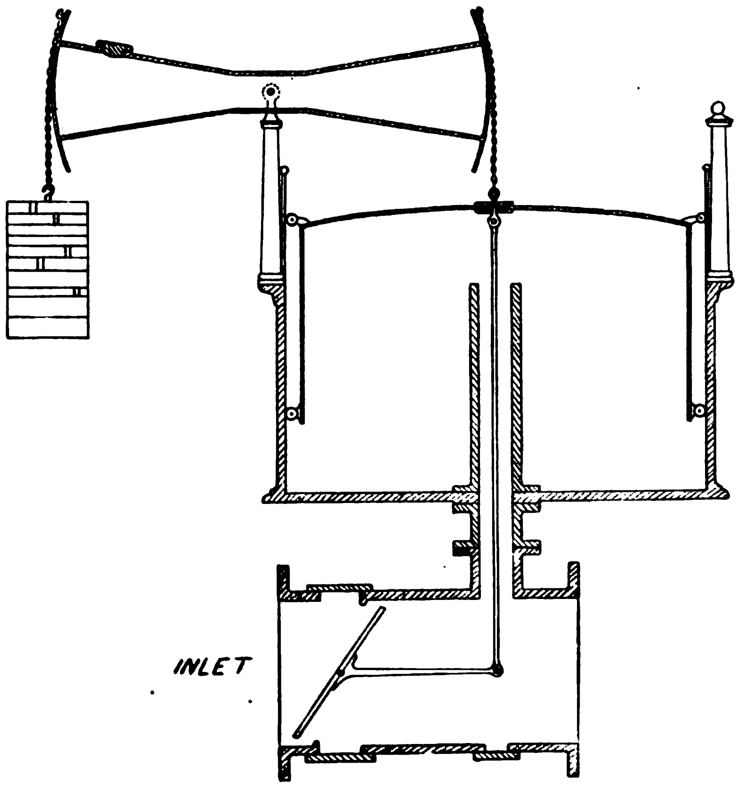
No. 18. Connelly Automatic Governor, 1883 (?).—This apparently is the first Connelly governor in process of evolution.

No. 19. Connelly Automatic Governor.—As advertised for sale in 1883.

No. 20. Connelly Automatic Governor, 1884-1899.—As the float descends, mercury flows from the outer vessel to the mercury vessel on valve stem, increasing the pressure. By varying the combination of compartments into which the mercury flows, and by opening or closing ports in the vertical sides of the valve, the governor can be adjusted as to the length of

stroke that will give maximum pressure, and as to length of stroke that will start to put the pressure on.

No. 21. Connelly Automatic Governor, 1900.—The central mercury vessel in this model is made of glass, and has a de-



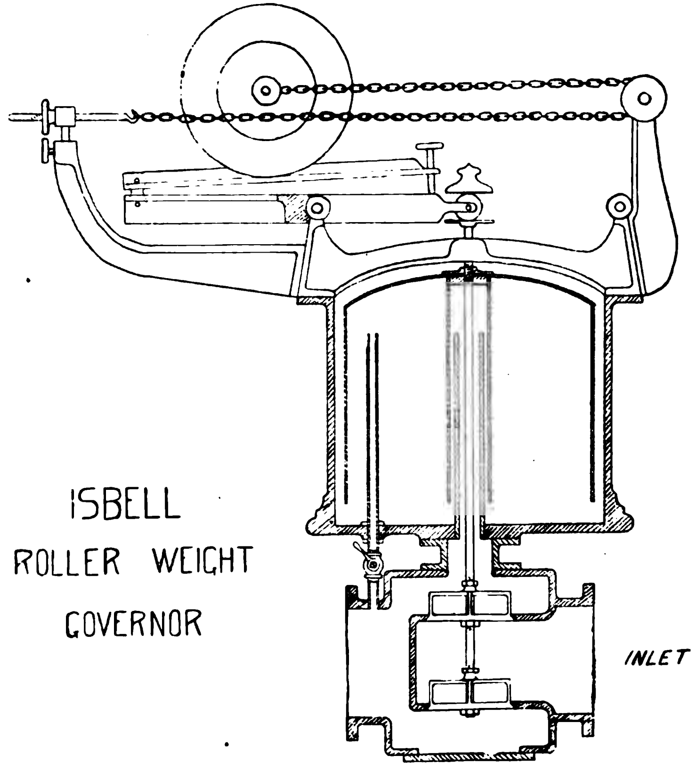
MERCURY ARM GOVERNOR
No. 11

placement block with a screw adjustment, so that mercury can be made to rise to any height, thus adjusting the length of stroke required to put on maximum pressure. The same governor without mercury vessel is used as a simple balance governor.

No. 22. Cathel's District Dry Governor.—This governor reversed the usual operation of governors, and instead of main-

taining a constant outlet pressure, it maintained a constant difference in pressure between inlet and outlet.

No. 23. Isbell-Porter District Governor.—Similar to the Isbell-Porter Standard Governor, but with a closed top and small pipe to atmosphere.



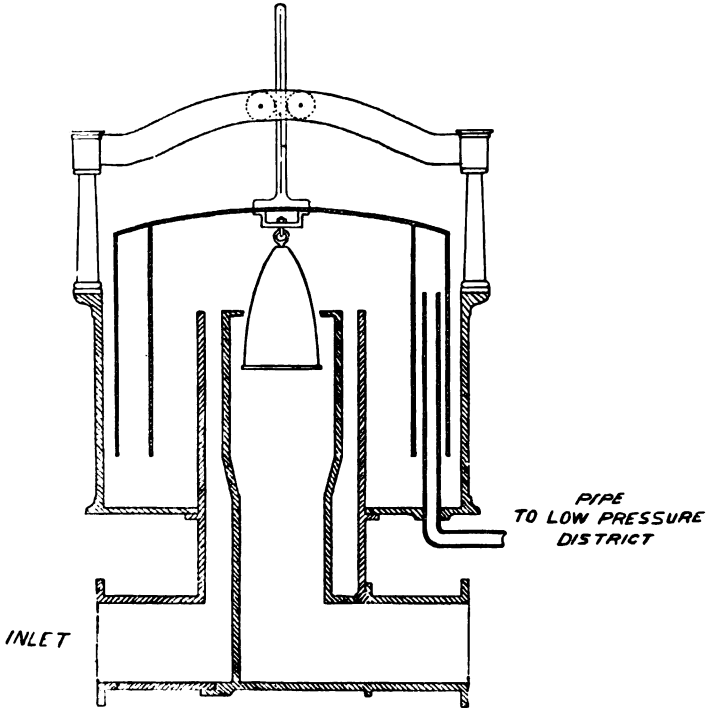
No. 12

No. 24. Hulett and Paddon's Siphon Governor.—The inverted siphon holds mercury, on which the float rests. Changes in level of mercury correct the pressure.

No. 25. Sugg Governors.—The tanks on these governors were so shaped that should the seal blow, the liquid would drop back into its place, instead of leaving the tank.

No. 26. Sugg Tandem Dry Governor.—The dry governor so often seen on old bar photometers.

No. 27. Williams' Balanced Valve Governor.—A simple and accurate balanced valve, mill or house governor. Will handle fairly high pressure. The top is tight fitting, except for a small "breathing hole," so that little gas could escape should the diaphragm dry out and break.



SERVIER SELF-ADJUSTING GOVERNOR

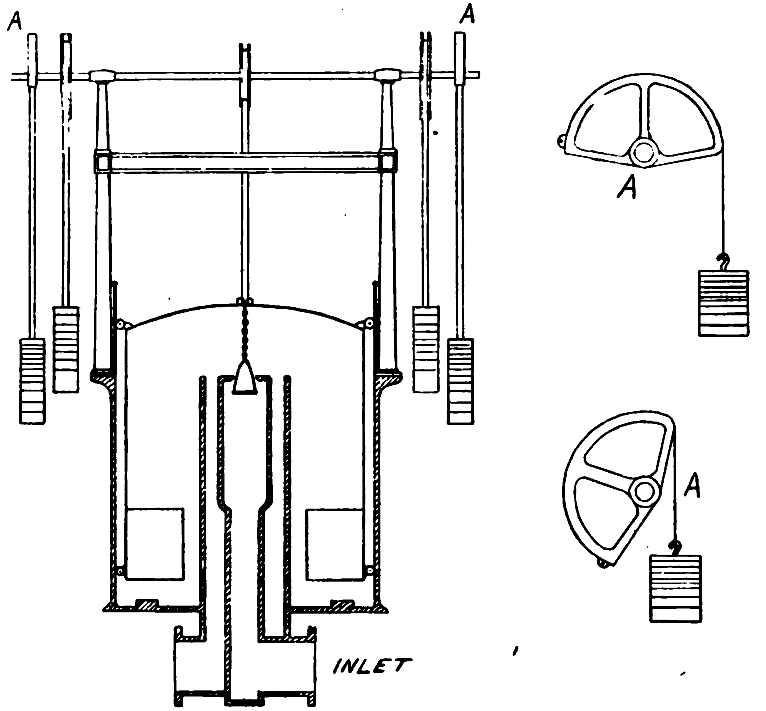
No. 13

No. 28. Pintsch Compressed Gas Governor.—The governor will control 1,500 pounds inlet pressure, absolutely sealing the inlet, with a scarcely noticeable rise in outlet pressure. The adjustment of the outlet pressure is by tension of the spring. The perforated cylinder at inlet end is to contain a strainer to keep pipe scale and dirt from the valve.

No. 29. Westinghouse High Pressure Natural Gas Governor.—Tested in 300 pounds pressure, but will take the

highest known well pressure and reduce to outlet pressure of from 5 to 50 pounds. The diaphragm plate and spring act as safety valve in case of dirt or scale under controlling valve.

No. 30. Johnson Reynolds Low Pressure Regulator.—This governor reduces an inlet pressure of 30 to 50 pounds,



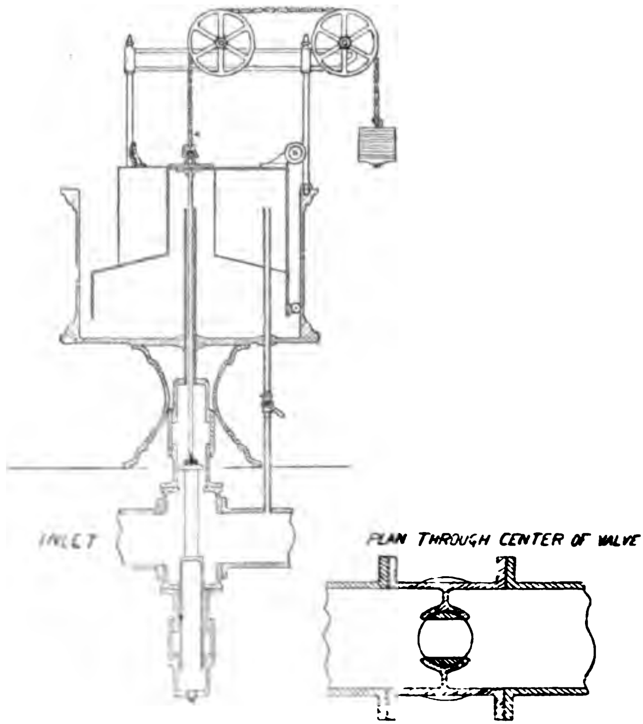
MILNE GOVERNOR

No. 14

down to an outlet pressure of from 2 ounces to 5 pounds. The drawing does not show safety valve.

No. 31. Young's Fuel Regulator.—With automatic cut off and dead weight safety valve for natural gas. In case of accident to diaphragm, or stoppage of supply, the diaphragm plate drops, closing off the supply and raising safety valve: No gas can pass again until the plate is raised by hand.

The President. — I think you will agree with me that this will become the classic for information on governors; for not only has Mr. Humphreys spent a great deal of time personally in making those sketches, but he also has been thoughtful enough to spend a great deal of money as well in this edition of his paper.



HOPPER AUTOMATIC GOVERNOR

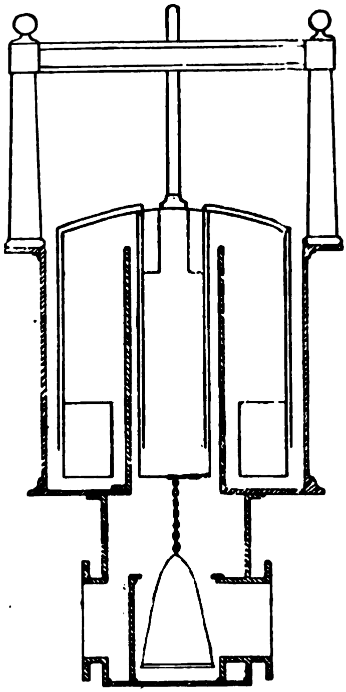
No. 15

Discussion.

Capt. McKay—I would like to express the great satisfaction one has in a paper of this sort, prepared with such care and so copiously illustrated with these very carefully drawn diagrams. I think it is something which serves, by referring to the lines along which advancement has been possible in the past, to

point to the lines in which development will be probable in the immediate present. I would also like to hear from Mr. Shelton concerning the regulators which he has actually used on those lines in which he distributes gas under high pressure.

Mr. Shelton — Capt. McKay's question brings out a comment that I think it only fair should be made on Mr. Humphrey's

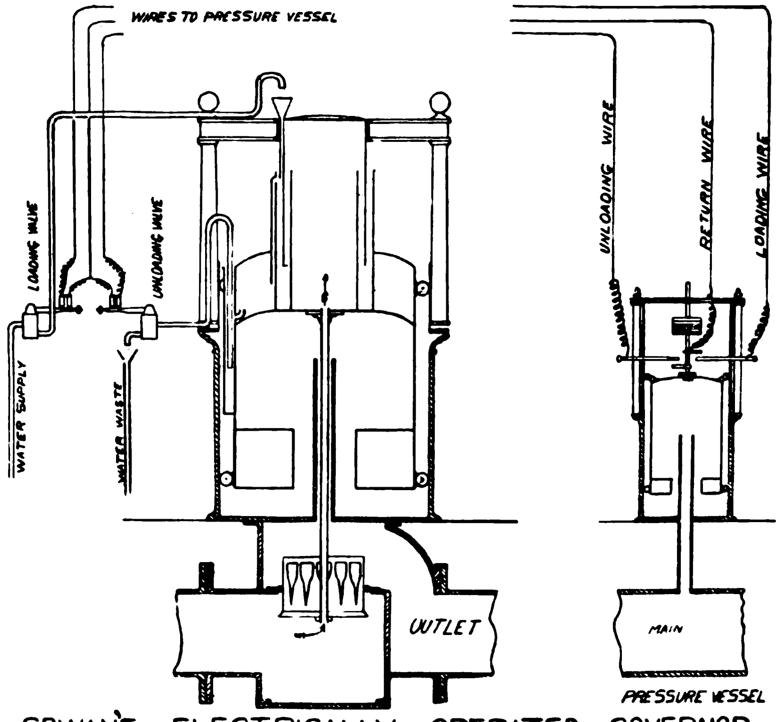


O'CONNOR-MILNE AUTOMATIC GOVERNOR
1897

No. 16

paper. I very much appreciate the work put into the collection of these illustrations of past and present forms of governors. Having been through more or less of that work myself, I think it is very valuable and something that ought to be encouraged —viz: The getting on record in our Association proceedings of thoroughly complete "round ups" of the various forms of our standard apparatus. It has only been done, I think, in two or three directions, and if it were done more generally and

more systematically the collected information would be of very great value to those who are looking up such subjects in the future. At the same time such information, to be of the fullest value, necessarily must be complete, and unless a thing is given as complete, and vouched for as a *complete* round up of the various forms, it is very apt to be deceptive and misleading to

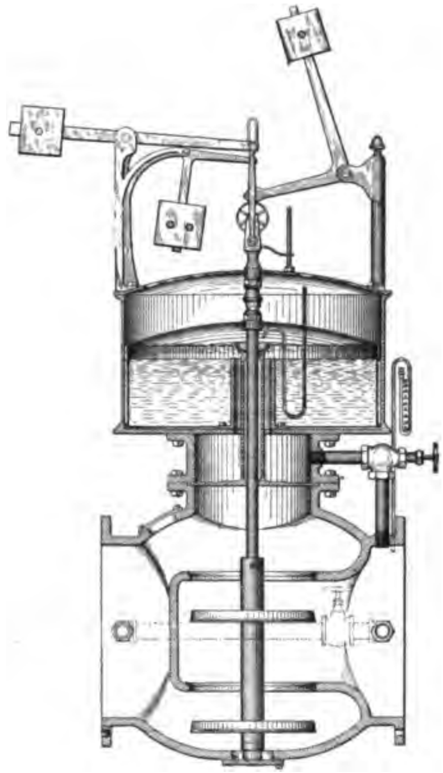


COWAN'S ELECTRICALLY OPERATED GOVERNOR

No. 17

some one who might make use of it, thinking that all the forms or all the facts were there, and not finding some quite important forms of apparatus that for one reason or another had not been covered. There are a few forms of governors which are not covered in the list that Mr. Humphreys has presented, and, therefore, I simply want to make a statement of fact, so the record may show that, while it is a very good collection of typical and representative forms of such apparatus, it is not

necessary (nor do I think it is so offered) as an absolutely complete record. Hence any one using it to look up in the future should supplement it by such other information as may be necessary. I say that because, in using artificial gas at such high pressures as 5, 10, 15 or 25 pounds, as I have been doing

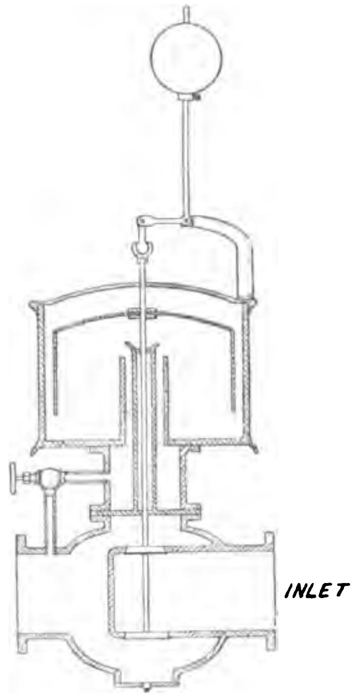


CONNELLY AUTOMATIC GOVERNOR

No. 18

in the last year in several instances (and universally with entire satisfaction as to results), I have used some governors which were not shown by Mr. Humphreys nor to which any reference was made. He illustrates one type of such as I have used, and I have used that type, but in another form. He also does not, very naturally, show the forms of governors for controlling

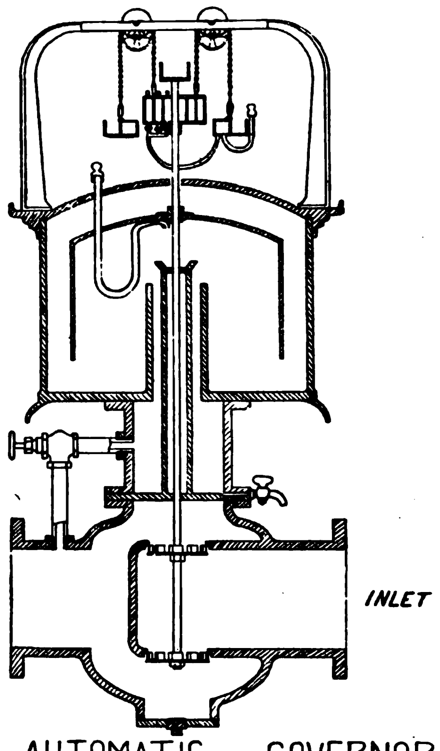
high pressure natural gas lines, which are different from the house, district and small, low pressure governors shown, but which are going to be used in the artificial business if high pressure is used to any extent. I merely want to bring out the point that so many different forms are used that one must be very careful not to take any statements as complete without



CONNELLY AUTOMATIC GOVERNOR
1883
No. 19

having fully looked up the records. Answering Capt. McKay's questions more directly, as to the efficiency, as I understood it, of the governors of the forms that I have been using, I will say he would be entirely satisfied with some of the little cast iron governors working on the diaphragm principle, of the Pintsch type or of the Johnson-Reynolds type, to which Mr. Humphreys has referred. They seem to do their work sub-

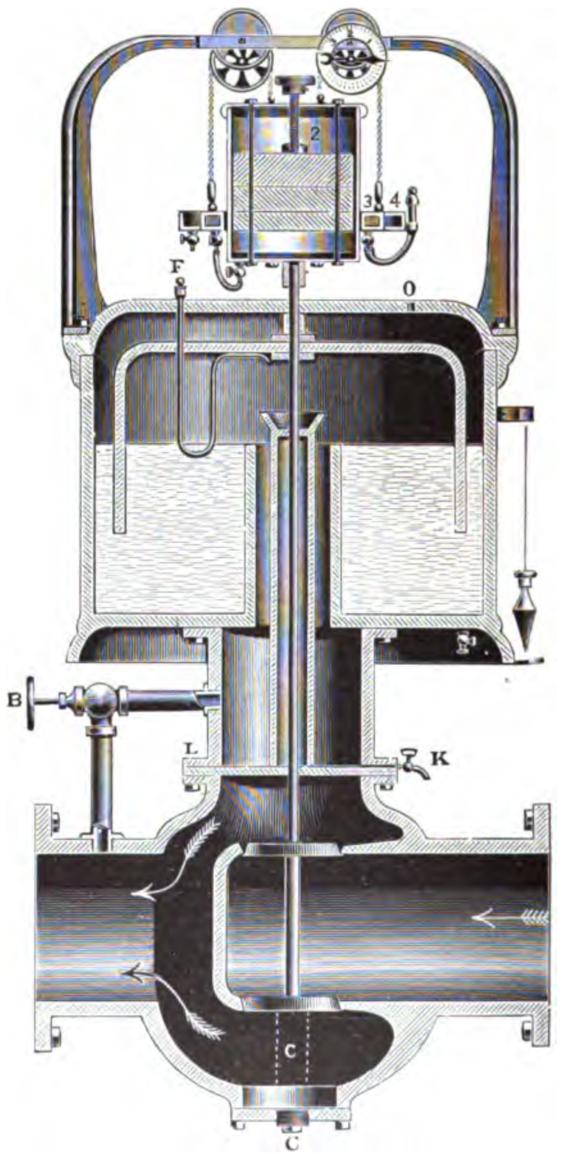
stantially perfect. Out of every hundred one or two may be defective—the diaphragm may have a little flaw in it. We make a practice of inspecting those before we put them up; but, generally speaking, we have no more trouble than in putting out the same number ordinary gas meters. We have no more complaints and we have no more looking after such appa-



CONNELLY AUTOMATIC GOVERNOR

No. 20

ratus to do. As far as the governors are concerned, I think they have been wonderfully well worked out for the particular work that is to be done. For instance, the Pintsch governor, as we know, is a marvelously perfect piece of mechanism. It controls practically any pressure on the high side down to any desired pressure on the low side, at one jump and under any conditions. With variation of temperature, the non-attention

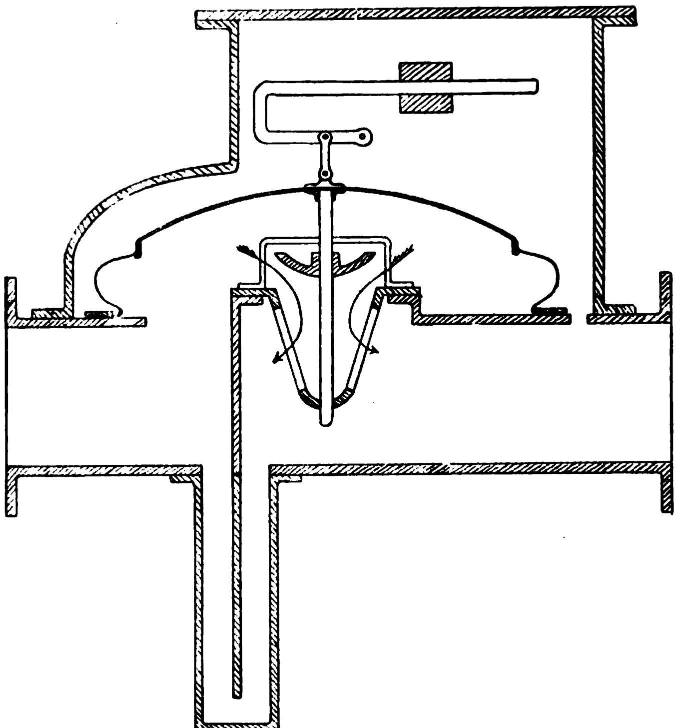


CONNELLY AUTOMATIC GOVERNOR

No. 21

and the various factors that go against the satisfactory working of such mechanisms, the Pintsch governor, I believe, is yet a practically perfect machine. Other governors of similar type are perfect for their particular work. One has to exercise, however, a good deal of care to pick out the right governor for the class of work to be done. For instance, the natural gas

INLET

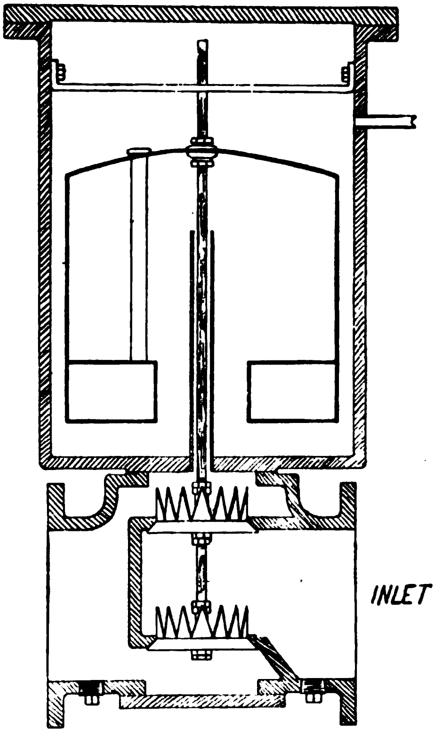


CATHELS' DISTRICT DRY GOVERNOR

No. 22

governors—that is, "low pressure" governors in the houses—are used to handle a good deal of *volume* of flow for natural gas in ranges, etc., at comparatively moderate *pressure*, say 10 ounces or a pound or 2 pounds or 5 pounds, permitted in the city. The Pintsch governors, on the other hand, are designed to handle very *minute quantities* of gas at very *high* pressures, 200 and 300 pounds. The governors that I have had occasion

to use have little different factors to contend with and different conditions to fit. They require to handle less gas than the natural gas governors, as a rule, more than the Pintsch governors, at less pressure than the Pintsch governors work at, but at more pressure than the low pressure natural gas governors



ISBELL-PORTER DISTRICT GOVERNOR

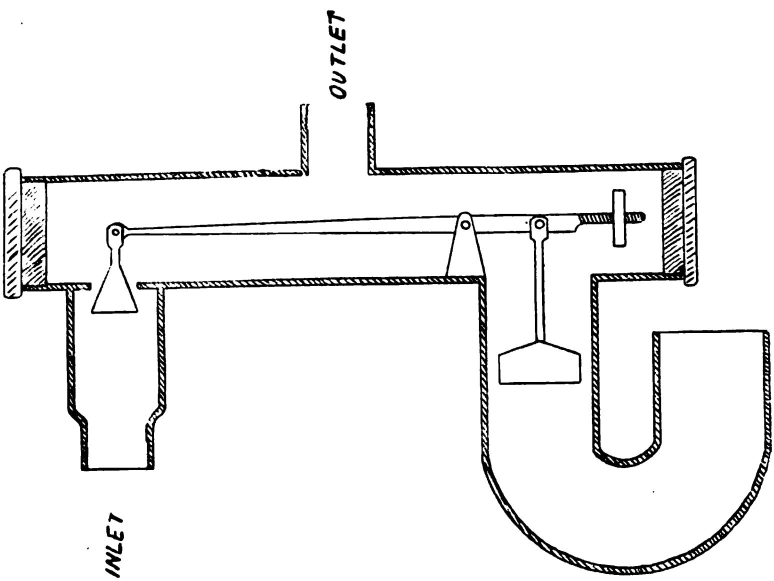
No. 23

work at, and that affects the areas of the diaphragms, the length of the levers, the areas of the passageways, etc. Hence, in using governors for any particular service great care has to be observed that the governor is adapted to the work that is to be done. I believe a governor can be made for any work desired. On the high pressure work with which I have been connected generally speaking we have had no trouble of any moment from governors of any description.

The President—In order to make this complete would you object sending to the Secretary some additional cuts of governors, if you have them, so that we could make the illustrations part of your discussion?

Mr. Shelton—I should be very happy to.

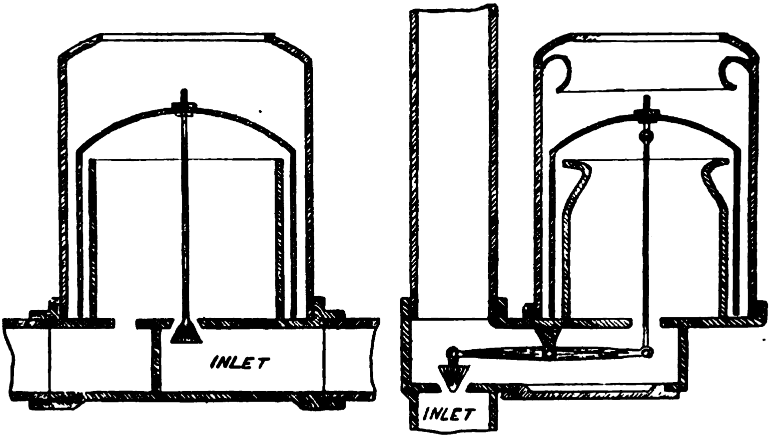
Mr. F. C. Sherman—I would like to ask Mr. Humphreys, if, while looking up this question of governors, he found a de-



MERCURY SYPHON GOVERNOR
HULETT AND PADDON

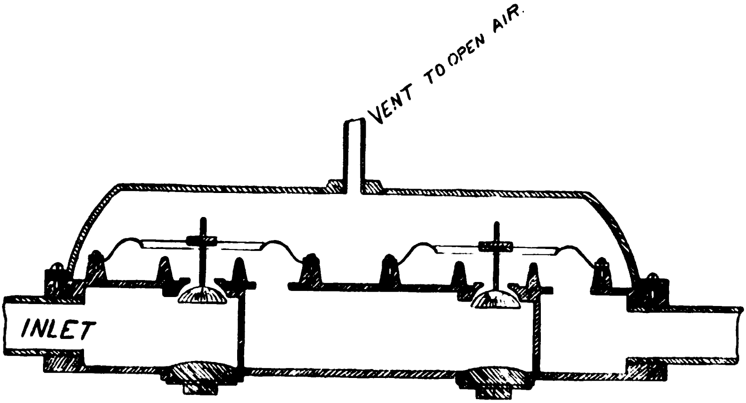
No. 24

scription of what is called Hunt's equilibrium governor. I ask that question from the fact that 25 years ago I copied a drawing or a cut of one as shown in the *American Gas Light Journal* and tried it at the Worcester (Mass.) Gas works, and it was a success. Since then I have removed the governors which I found in use at New Haven, Conn., and put in their place this Hunt's equilibrium governor. They were made in Worcester at the time I was there. One was sold to the Springfield



2 SUGG HOUSE GOVERNORS
1884

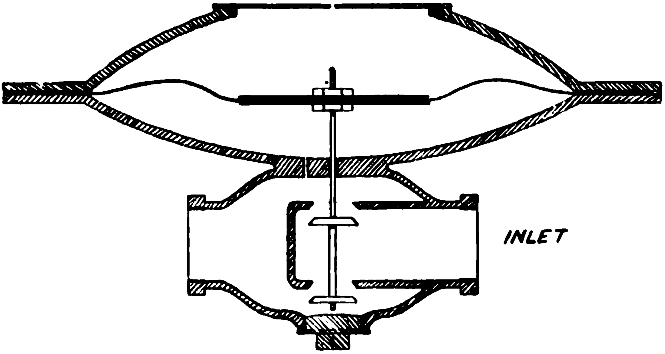
No. 25



SUGG'S DRY DOUBLE GOVERNOR
1884

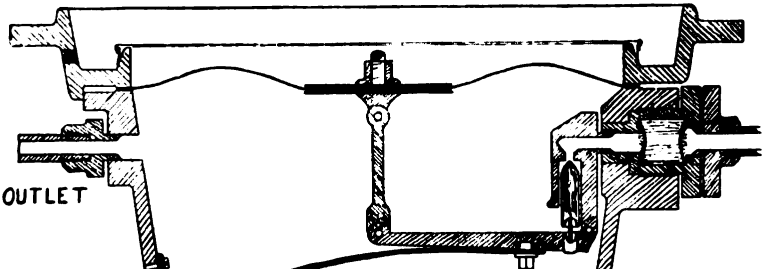
No. 26

(Mass.) Gas Company and another to the Holyoke Gas Company. As far as I know they give satisfaction. I speak of them because the cost is merely nominal, in fact very slight as compared with what you have to pay for other governors.



WILLIAMS' BALANCED VALVE GOVERNOR

No. 27

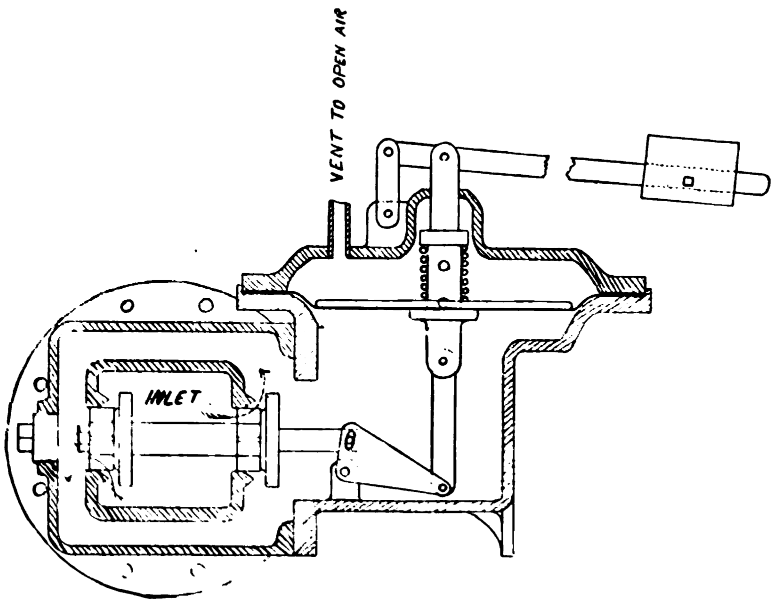


PINTSCH REGULATOR

No. 28

Mr. J. J. Humphreys, Jr.—As my drawing was done at night and as I needed some sleep, I named the paper "Some Sketches of Gas Governors." I made no pretence of covering the ground thoroughly. As an actual fact I searched out something like 60 or 70 and only had time to draw 30. I had inklings of

where I could find about 30 or 40 others, so I thought I had better stop. The Hunt governor was left out for that reason. Of the natural gas governors of which Mr. Shelton speaks I have only drawn three, although I found very many of them—all of those mentioned in Mr. Shelton's paper at the Paris Exposition, of course—and he probably knows many more, and



WESTINGHOUSE HIGH PRESSURE GOV.

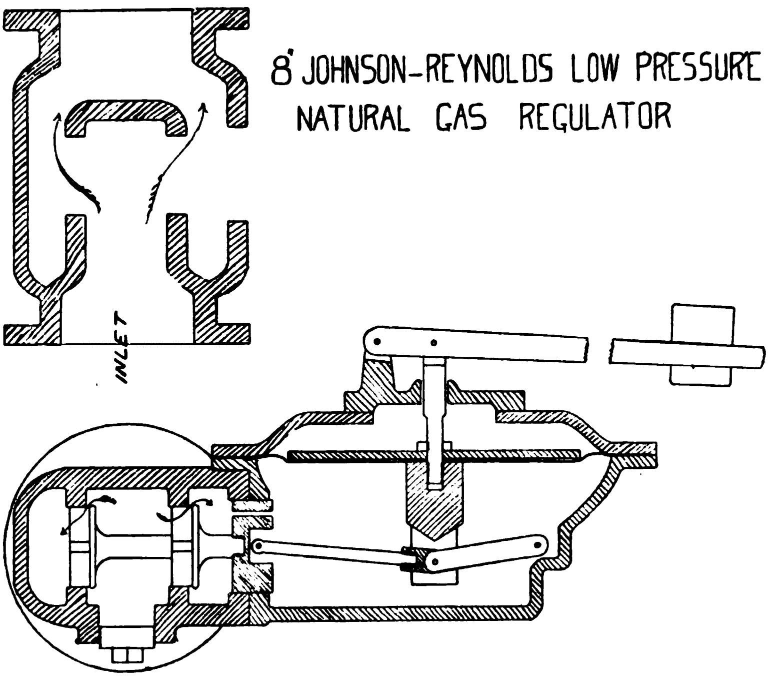
No. 29

then a great many from the makers of the natural gas governors, which I did not put in.

The President—Mr. Shelton, I did not know that in your paper at the Paris Exposition the high pressure governors were illustrated. If so, as the paper is mentioned in the Humphrey's paper, perhaps those cuts could be added.

Capt. McKay—Will Mr. Shelton state the pressures on either side of the governors which he has in use on these high pressure mains—that is, the reduction of pressure which is effected?

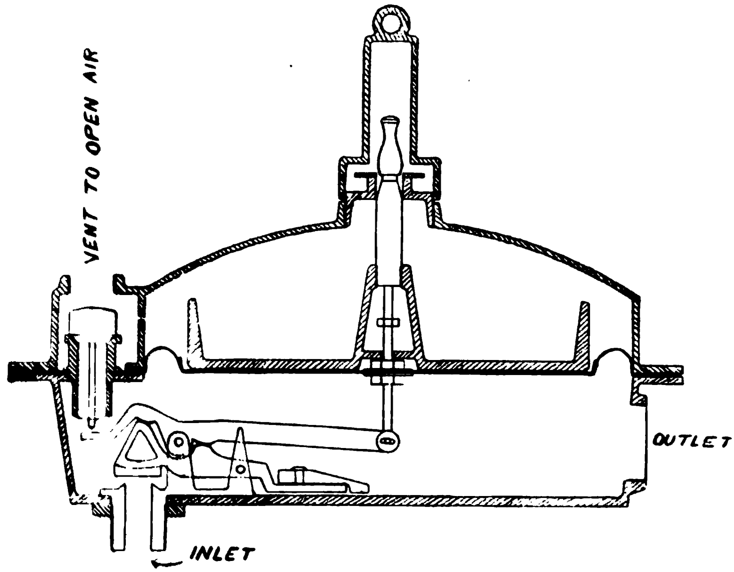
Mr. Shelton—Readily. The first one I believe we worked at a range of from 20 to 30 pounds pressure. In that case we wanted to convert that varying pressure on the high side into the low pressure mains, bringing it down to about 2 or $2\frac{1}{2}$ in. ordinary pressure. We concluded that the governing would be rather more delicate if we used two governors tandem. We simply used the mechanism that our natural gas friends had worked out, rather than try to evolve something



No. 30

ourselves for which there was no need. We used a natural gas governor warranted to cut from 50 pounds to 5 pounds at one clip, and following that a second governor to cut the gas from 5 pounds to a couple of inches pressure. We found, as a matter of fact after connecting them up, that one governor was not in balance and the other one was doing all the work. We put those in at first because it was desired to be on the safe side and have the utmost possible delicacy of control, and two governors taking successive steps seemed to us

a little bit safer. Upon looking into the matter, however, as time went on, and we had more chance to investigate what was done, we came across other governors which do the work at one clip. We have governors in use on another pipe line, jumping from 40 pounds on the high side to 40 tenths, or 20 tenths (26 tenths, I believe they are set for), on the low side. They hold that pressure within one or two tenths right along on 24 hours' run. They are practically Pintsch governors in that way, you see, as far as the work done is concerned—the high



YOUNG'S NATURAL GAS REGULATOR.
No. 31

pressure on one side is many pounds, ranging 5, 10, 20, 30, 40 or whatever we may happen to be running. When we make additions to the high pressure pipe system we run the pressure up for the purpose of testing the pipe beyond the pressure that we carry for ordinary working, which is perhaps 10 or 20 pounds. We have a number of house governors all along the line of 2 or 3 high pressure pipe lines, and those little house governors, that look like cast iron pots with a diaphragm inside, costing $3 or $4, and set in advance of the meter, convert the pressure

from 5, 10, 15, 20 pounds, whatever the pressure may be on the high side, to 17-tenths water on the low side, which is about what we set for in house private services. Those governors are protected by a device which, if they should fail to work (and such a thing very rarely happens) the gas cannot get into the consumer's cellar or into the meter, and are further protected, so that if both the governor and the protector should fail to work, no more gas can get into the premises than would come in under ordinary low pressure on the ordinary inch service. We believe we have our protection absolutely complete and not dependent on mechanism as against the safety of the customer. The devices cut from 20 pounds or any varying pressure on the high side to whatever we set them for on the low side, and they only vary a tenth or two, sometimes not that.

Capt. McKay—I understood Mr. Shelton to say that these governors were set on the inlet of the consumer's meter?

Mr. Shelton—I mean between the stone wall of the cellar and the inlet of the meter; in advance of the meter.

Mr. Coggeshall—On page 14, Mr. Humphreys probably shows what is really known as the Kidder governor. It is only one part of it. There are two sections. What is here shown sets on the floor, and this sets on another holder below the floor, which regulates the valve in the pipe. There are two holders to it. Otherwise it is all right. I have used it for 20 years, and it is perfect, automatically shutting out the gas, commencing to shut off about 11 o'clock to 1.6 inches, opening as the demand may be the next day.

Mr. W. A. Learned—I think Mr. Humphreys spoke rather disparagingly of a district governor. We have had three district governors of the type shown on page 26—Isbell-Porter district governor—in use for 3 or 4 years. We use in it for a liquid water and glycerine. It is in a manhole thoroughly sealed with a type of cover that the telephone people use. It works very nicely. There is a governor that is equally as good (the Connelly) without the automatic attachment, that could be used for a district governor.

Mr. J. J. Humphreys, Jr.—I did not know that I spoke disparagingly of district governors. I don't see anything here indicating that I did, and I did not mean to.

On motion of Mr. W. A. Learned, a cordial vote of thanks was passed to Mr. Humphreys for his paper.

The President—It is after the time of adjournment. I want to call your particular attention to the fact that two important papers for the morning are on our list: "How they Do Things on the Other Side," by Mr. F. H. Shelton; and on "Selling Gas," by Mr. C. J. R. Humphreys. Hence I trust you will come together promptly tomorrow at 10 o'clock. In addition to those mentioned we are to have a few words on "Inclined Retorts." I don't know to what extent his paper will be, but Dr. Schniewind will be here, and I am anxious to have this paper of Dr. Schniewind's read at the meeting rather than out at the coke works. You are all invited to go to the coke works tomorrow afternoon. I don't know definitely the hour. If the worst comes to worst so far as getting through, why, he will have to read that paper, probably at the works, but I trust it will be read here, so that we can get the discussion we ought to have and then take your entire time in looking at the works. We have not yet heard from the Nominating Committee. You will listen to the

Report of the Nominating Committee.

Mr. Charles F. Prichard, from the Nominating Committee, reported the following list of office bearers for the ensuing year:

PRESIDENT—Mr. Waldo A. Learned.

VICE PRESIDENTS—Messrs. William E. McKay and Frank S. Richardson.

SECRETARY AND TREASURER—Mr. N. W. Gifford.

DIRECTORS—Messrs. Walter G. Africa, William McGregor, William H. Snow, Joseph E. Nute and B. J. Allen.

Election of Officers.

On motion of Capt. White, the Secretary was instructed to cast the ballot of the Association in favor of the election to office of the gentlemen named by the Committee on Nominations. The Secretary having announced the result of the ballot, and the President having declared the nominees duly elected, the President elect was escorted to the Chair by Capt. McKay, to

an accompaniment of cheering. When the cheering had ceased, President elect Learned, said:

Gentlemen of the Association, I thank you for the honor conferred upon me. I realize full well the responsibilities of the office to which you have promoted me. My best hope is that our next meeting will be as successful as the present one, and I know that it will be with your co-operation. (Applause.)

The President, in resuming the Chair, announced that the time for adjournment had arrived, and a motion to that effect was carried.

SECOND DAY, FEB. 20.—MORNING SESSION.

The President, in calling the Association to order for the sessions of the second day, asked the members to be prompt in their attendance and attention, since it was proposed that a visit to the Everett works of the New England Gas and Coke Company should be made early in the afternoon.

The President then introduced Mr. G. H. Finn, General Manager of the New England Gas and Coke Company, who formally invited the Association to inspect the Everett plant at as early an hour during the afternoon as it was possible to appoint. The President thanked Mr. Finn and his Company for the invitation, and called upon Mr. C. J. R. Humphreys, of Lawrence, Mass., to read his paper on

Selling Gas.

A very prosaic title for a paper is, perhaps, your unuttered criticism; and I am going to take issue with you on that point. On the contrary I stand ready to admit that the title sounds—what shall I say, very tiresome? But, be that as it may, I am more and more impressed with the importance of the subject I have selected for your consideration. I daily grow in the knowledge of the fact that the prosperity of a company depends largely on the proper selling of its product. I have had this brought home to me on many occasions when, having to deal with the valuing and remodelling of gas plants, it has become perfectly clear to me that the factor of prime importance in considering that part of the problem, called the future earning power of the property, has been the quantity of gas which the plant could be made to sell. Nor should we be

surprised at this thought, for it is in a line with other commercial ventures, where we note that the utmost importance is given to the selling department. You will have to pause but a moment and bring to your mind the recollections of the vast sums of money spent by many firms in advertising and in keeping commercial travelers on the road, to feel that well known facts within your memory verify my assertion that in general mercantile life today selling the product is the controlling feature of business life. I, therefore, feel, while the subject I have chosen is prosaic and dull, its importance must stand as my justification in presenting for your consideration some few thoughts on this theme.

Let us look for a moment at some of the methods to be pursued in gaining new business, and in this connection it will, I think, be generally conceded that the objective point which it is necessary to keep immediately in view is to attract the attention of those from whom we wish to secure business; and undoubtedly there are many ways to work out this scheme.

I sometimes hear a manager make the remark that he never secured any business from advertising, but was successful when he resorted to canvassing, or that advertising has paid well and canvassing has been a failure, or that some other plan he has employed has produced excellent results. For my own part, I have never been able to differentiate between the various plans I have adopted to secure the attention of the desired customers, and I think we are prone to waste thought on this aspect of the case, and we should be ready to feel that all the schemes we are likely to pursue will, in a greater or lesser degree, converge to the one point—that is, the increase of our business. I remember well, when the Lungren lamp first came upon the market, I put a canvasser to work on the business streets, and in short order had several hundred of these burners lighting the stores of the city; and when the Welsbach became a commercial success I seemed to secure good value from advertising the new light by having a large burner painted on one of our wagons; it was handsomely done — showy and attractive, it immediately caught the attention of the people.

I believe firmly that well nigh all advertising plans have their value, and that the canvasser enters into and is a large part of our problem. Other factors are the well displayed "ad." in the daily papers; the pamphlet, which touches upon

some one topic in connection with the gas selling theme; the neat handbill; the large posters placed conspicuously around the city; these are but other means to work in and help the canvasser, and in turn the canvasser helps the various other plans we may adopt. Suppose, seeing a store lighted by some other means than gas, we should send a canvasser to talk with the proprietor. He may perhaps find the latter grumpy or busy—some printed matter left in his hand may do some good. Say there is a store near by lighted by gas, but poorly, owing to old and defective burners; let us go to the latter and secure his consent to place a couple of Welsbachs in his window, and later call the attention of the desired customer to this window, and perhaps we may land our man. If not, perchance another circular we may have in hand, treating of the Welsbach in a different vein, may catch him; but if he is still obdurate, we might offer to put in a couple of burners, even if we have to do a little free piping, and the chances are we have secured a customer. We should not use too much time or waste too many pencils in figuring whether the profit we will make out of this customer will pay for the time and energy expended in securing him. I am sure if we take so narrow a view of the problem we will miss our game, because we cannot guage the benefit that customer will be to us. His neighbors, in competition with him, must do likewise, and we do not know how far reaching may be the influence of this one customer. We have secured a customer; that is sufficient. Let our judgment as to the wisdom of the policy rest on the results of several years' work.

Again, there is a householder whose name is not on our gas ledger. How will we treat the problem? Send a canvasser to call there in the day time and see the lady of the house? Well and good, let us try it; but if the canvasser meets with a rather snappy reception we have only run up against what we should have expected. But you say the canvasser is thick-skinned, he does not mind, and will keep at it. For the good of the business we must desist. Approach the problem in some other way. We were perfectly well aware that the lady would not care to discuss the matter until it had first been considered in family council. Get the subject up there for discussion.

We are using our space in the daily papers to set forth some of the advantages of gas for lighting. Today we have

some closely set type matter in the centre of this space; tomorrow we have a cut of a Welsbach or an attractive reading stand, and we send our proposed customer marked copies of the paper. We should have a small booklet in hand treating of one phase of the subject very concisely — not over 400 words in length — it need not be expensive, but it has a catchy cover. Send them one; but they do not call to apply for gas. Very well, write them that a representative of the company will call on them (naming the time). We may be met with the remark that they have not used gas, and that they are afraid of it. Ask them to call at the office, and then in the show room — of course, all companies should have one—we can show them the different burners and stands and make them see what an excellent reading light a Welsbach makes. We have three different shades, of many shapes and colors, and will doubtless have something that will attract them. If, however, they will not call at the office we might take a pretty table-stand-and-light up there in the evening, and even though we cannot show the lamp in action, it will be a help. Leave them a booklet on gas heating stoves, and later another one on the gas range. If all such work fails, we can probably gain our point by offering to put in a gas range on 30 days' trial at our own expense, and then, while this is being done, put up a bracket light in the kitchen—the gas pipes will grow.

I think it well to bear in mind that we wish to secure customers for lighting. It is well to offer this gentle reminder in these days when we are putting so much energy into the extension of the use of gas for purposes other than lighting.

At times we hear the remark made that the Welsbach burner has reduced the gas sales for lighting purposes; for my own part I do not think this should be so. We have here at our command in the Welsbach a powerful aid to use in our efforts to secure new business. The low cost at which lighting can be done by means of this burner, the brilliancy of the light, the readiness with which the burner lends itself to effective schemes for lighting, are but some of the reasons why I am urgent in the claim that the Welsbach is a means which, if rightly employed, will lead to the increasing of our lighting business. It goes without saying that we should have in our own office examples of this means of lighting, both effective and striking.

Let us now consider some of the secondary uses of gas, for these are well worthy of our careful study and persistant encouragement, and we have rather more scope to our scheme in calling the attention of the people to the uses to which our product can here be put. In advertising we have the opportunity to display considerable originality in designing our "ads.," and in a general way, it may be said such remarks should be administered in small doses, both in the daily papers and such circulars as may be sent out. We should have some printed matter always in hand. The small booklet, dealing with, say, one aspect of the gas range question, and containing a few receipts from some well known expert, is a good means of directing attention to this particular branch of the industry.

Then, again, the gas bill can be usefully employed as a reminder. I have before now arranged with grocers to give them brown paper bags with a gas stove "ad." printed thereon, and the indications were that these directed attention to the usefulness of gas in the kitchen; and I am of the opinion that it is most advantageous to use many of these means in advance of the canvasser in order to excite curiosity and interest prior to the personal call. I think, too, that lady canvassers can be used to good advantage, because the lady householder, unacquainted with the gas stove, is so ready to raise objection to the effect that it will not do certain kinds of work, and these contentions are well met when the caller can speak from personal knowledge and experience and discuss the subject on lines which clearly show a personal acquaintance with the details involved. A proposition from the canvasser, to the effect that the gas company will set a stove free for 30 days' trial, will generally meet the objections of the most obdurate, if the householder takes sufficient interest to discuss the subject at all. When, however, all these means fail to interest a party, the end can sometimes be attained when noting the person calls to pay her bill—if she already be a light customer; and we should then be prepared to show her the results of the gas range, in the shape of well baked bread or a nicely browned cake. In fact, it is a good paying investment to have some articles, cooked by a gas stove, on exhibition during the days when the office is most crowded. I have followed this plan, with, I think, excellent results.

The cooking lecture also stands as an effective means at our

hands; not only the lecture in a large hall to which the public is generally admitted, but the informal talks in perhaps the company's office building, on certain days of the week, when special invitations are sent out to a limited number. Some gas companies have tried the neighborhood plan, setting up a gas range in a customer's house and then inviting the neighbors to see it operated. Others have gone so far as to set up a stove on the sidewalk, and in that way excite the curiosity and win the attention of the people. I have heard of these schemes being worked with good results, but I cannot speak from experience as to either plan.

Many companies approach the problem from an altogether different standpoint. They say it is better for a gas company not to appear openly in the matter, that the stove dealers should be used as allies, and a bonus should be given them for every stove they place. In support of this theory we are met by the contention that the public feel suspicious of gas companies, etc., etc. Personally, I have little patience with the latter thought, and my experience is not favorable to this plan for catching the attention of the people. There the gas stove is likely to be shown with a background of other stoves, and it does not stand out prominently, whereas in the show windows of the gas office the display of gas ranges is more than conspicuous.

It, however, is not my purpose here to allude to all the methods to be used in bringing to the attention of the people the product we have for sale and that they need. All I am attempting to do is to say in a round-about way that if we have anything to sell we must put much thought into the problem of bringing our goods to the attention of those whose trade we seek, and that all kinds of plans must be adopted. The subject must constantly be on one's mind, and we must keep everlastingly at it.

We now come to the discussion of the question how we can help and aid a party in his desire to use our product; and here we are brought face to face with the question whether we shall make the party pay full price for all the appliances by which the gas can be conducted to the burning point, or whether we shall make it easy for him by lightening the cost of installation. Shall we charge for services, or run them

free? Shall we charge for meter connections, or retain undisputed ownership of the same? For my own part, basing my judgment on my own experience, I favor free services and free meter connections. I am in favor of making it thus the easier for a party to obtain the goods we have to sell. I have oftentimes been met by the statement that a customer is perfectly willing to pay for the service, and if such charge be not made it is so much money thrown away. This I can hardly follow. I am, however, willing to admit that such charges would not retard the growth as much in some cities known for their wealth as in other places where people must perforce count costs carefully; still I cannot help but feel, having in mind my own experience, that free services and free meters would add to the number of consumers in any place. In England, as we all know, the sales of gas have been enormously increased by the practice adopted in many places of piping houses and putting up fixtures, and charging, in one form or another, a rental on the cost of the installation. This is a valuable means of getting a certain line of trade, and has been tried, I think, to a limited extent in this country.

In the manner of aiding our customers in adopting the gas range we meet with very divergent views among the members of our profession. Some managers hold that it is not good policy to help the would-be customer at all, but leave the business to be cared for by the stove dealers. Others will sell the stoves at a profit over the cost as set up. Again in other cities we find the practice of selling the stove at its cost to the company and setting it up free, while some figure to take a loss of $5, others more, on each stove sold. Here, again, it will be found that the same rule cannot hold in all cities and towns; the size of the place, the character of the population, the amount of wealth therein, must all be considered as factors in the proposition. But I think those companies which have taken the most trouble in handling the business, have put the most thought into it and have pursued the most liberal policy, are those which have met with the greatest measure of success. Surely it is less troublous to stand by and allow this business to be handled by the outside trade, but there are in my opinion many reasons why this is not generally good policy; and one reason, by no means unimportant, is that the gas manager can lead a customer aright in choosing a stove much better than the average tradesman. Remember, a gas stove in active

operation is there for good or ill—you will hear of it again in many other places, either by good report or bad, and one of the important considerations to be kept constantly in mind is to see to it that every gas range sold is a standing advertisement of the business. As to how much money shall be lost on a gas stove, I can only say each manager must consider for himself; but my experience leads me to say that, in all the places where I have come into close touch with the business, it has appeared that the cheaper the stove is sold the more are placed in position. Some managers prefer to fix a price for the stove and include in that 5,000 feet of gas, so that a customer buying and paying for a range can use 5,000 feet of gas in that stove without further cost. Another plan, followed with success is to connect up a range and say to the customer when he has burned 20,000 feet of gas through the stove the range is his. Personally I have not tried either of these plans, so cannot speak from knowledge, but it would seem that one out to these schemes is, that they involve separate meters for the stoves. From my correspondence with other managers, I am inclined to think that the most general way of handling the gas range is to sell the stove at about $1 below cost and set it up free. I favor selling ranges below cost, and go farther and allow a customer to take the stove on the installment plan, if he so desires. I also think we have added to the popularity of the scheme of cooking by gas in having a lady, who is an excellent cook, follow up every range sold and instruct the purchaser how to use it, and to demonstrate the correctness of our claim that all cooking can be done on the gas range better than on any other kind of a cooking stove.

I have found that circulars put into the hands of architects and persons about to build, giving some points on house piping, showing how a pipe should be run from the meter to the kitchen for the gas stove, as the house is being built, bore good fruit. And a suggestion that, in new houses, arrangements should be made to heat the kitchen from the general heating system has given us all-year customers for the gas range.

What I have said about the conduct of the gas range business applies in part to gas for heating purposes. A booklet on this subject is always in order. The space in the daily papers can be used at the proper season advantageously. The gas bills also can be made to carry a message on this subject, and some companies do not hesitate to use the canvasser for

the heating stove as well as for the gas range; but the fact that the heating stove is so much smaller in cost makes it easier for the company to sell it without taking a loss. I, however, have not as yet seen anything in the more general subject of gas heating—that is, from a central point like the furnace—which leads me to look at this problem very hopefully.

There are many uses to which gas can be put in a mechanical way, notably in the matter of power, but these are very largely governed by local conditions, and everyone should make a study of the industries in his own place to determine what can be done in this direction. The gas engine business can I think best be handled by personal work—visiting each place where power is or could be used, and showing the proprietor how the gas engine could be adopted to his advantage. Gas is used largely in laundries, in can factories, and for general soldering purposes; and, when employed on a large scale, air under pressure is used to make the work more rapid. For japanning, brazing and many other purposes gas can well be used, and this must be made a subject of study in each locality. Prepayment meters stand as a valuable adjunct in helping customers to the use of gas; the fact that people can pay for a quarter's worth of gas as they need it puts the various gas appliances within reach of a large portion of the community which hitherto have not had the benefit of gas. And now that this style of meter has passed beyond the experimental stage, I feel sure that it has a great future for itself, and will act as an aid in the extension of the use of gas to a degree which we now fail to realize.

Working on the lines indicated, I have increased the house and store business 300 per cent. in 10 years in a city which has not had a very rapid growth, which is to my mind an ample justification for the policy I have pursued in selling gas; and I am confident I could not have attained these figures had I not resorted to several of the plans I have noted in this paper, and many others, for promoting the sale of our product.

If the objection is raised that, where gas is used for so many purposes, and where a company is supposed to keep in such close touch with all the innumerable uses to which gas can be put, the entire services of one man would be required for this department, I answer, "Yes; and a good man." In all

but the smallest of companies it pays, in my judgment, to organize a selling department, and the man in charge thereof should compare favorably with the other heads of departments. Again, I ask you to direct your thoughts to other industries, and do we not there find that the selling department is a very large and important part of every concern's organization? In moderate sized establishments do we not find as well equipped and as well paid men in charge of the sales as in the manufacture of the goods? And in large corporations do we not find the selling department intrusted to a very large firm, whose long experience and thorough knowledge of the ways of the public pre-eminently fit them for selling the product? Are the conditions surrounding the gas business radically different? Somewhat at variance with the conditions in general trade I will admit, but not so dissimilar as to destroy the comparison. And so I contend that the selling department of a gas company should be organized on the same intelligent lines as prevail in the manufacturing department, and should be under the immediate charge of as well trained an executive as the other divisions of the company's work. I am sure the largest gas companies could well afford to have the best of talent at the head of the sales department.

Another thought I would offer would be, that wherewe make our mistake—but I think I must qualify the word mistake later—is in not reconciling ourselves to a very considerable loss in the selling department for a few years. In several cities in the West and Middle States many gas companies have allowed thousands of dollars to be spent in 1 or 2 years in this direction, where we in this section would not spend as many hundreds of dollars. But the conditions are different, and as I stated a moment ago, I must qualify the word "mistake," because in many instances where we try to keep our losses down in this direction it is not because we do not appreciate the wisdom of being more liberal in this regard, but because we have the footing of the balance sheet at the end of the year in mind, and we must regulate our losses to what we can afford out of revenue, whereas in many other localities the companies take greater liberty in charging up the money spent in obtaining new business.

This brings me to another point. The money spent in securing new business, in all the various means of advertising,

in running free services and setting meters without charge, and in selling gas stoves below cost, while not, when considered on conservative lines, a proper charge against capital account, yet is not strictly a charge against the revenue for the current year. And if it is taken care of in the latter way the expenditures are kept down to such narrow limits as to make the growth comparatively slow, and, therefore, I feel the better plan would be to spend in 1 year the amount which would ordinarily be expended in 5 or 10 years and to make of it a special account, which would be charged off in a given number of years. Particularly would I advocate this policy where a company has in the past not devoted much attention to the selling of gas, and I would urge such a concern to crowd into 1 year the work which a more conservative policy would spread over 5 years, and in that way gain the full increment of new business as promptly as possible.

In conclusion I would urge these thoughts. The selling of our product demands from us our best consideration, and the immediate oversight of this part of our business should be under an able man who, in even a moderate sized company, would devote all his time to this matter, and that he should keep in such close touch with the business and the peculiarities of his own territory that he would be ever finding new uses to which gas could be put.

I would urge the utmost liberality in adopting different plans for bringing to the attention of the people the product we have to offer, and not be too ready to think that any kind of intelligent advertising does not pay, but to have confidence that the different plans work in, one with the other.

I would urge a like liberality in dealing with the customer in helping him to obtain the appliances he may need for the use of the gas, and that we take proper means to instruct the customer that he may get the best results from the appliances.

Finally, I would raise the question whether it would not be wise for this Association, through a proper bureau appointed for that purpose, to take steps to ascertain from the members the different purposes for which gas is used in each member's territory; such information, grouped, and placed in the hands of each member, would, I think, be a further aid to the object which I am sure we all have at heart—the increase of our gas sales.

Discussion.

The President—Gentlemen, I think I am not very far afield in saying that this is the most important paper presented to us thus far in this meeting. I want to indorse the suggestion made at the close of the paper in regard to the appointment of a committee of this Association to look into the methods used by the various members of this Association and also as to what purposes gas is used for. We believe in Boston in selling stoves at less than cost, except when it comes to selling on the instalment plan, in which case we try to get at a just cost. We are trying the experiment of giving a reduced price beyond the advertised discount for 1 stove, to persons who use 5 stoves, 10 stoves and 25 stoves, respectively, so that quite a low price is given on the stoves in large numbers. We believe in advertising, provided the advertising is done at the right time. You may readily waste a great deal of money by advertising a device when the people are not looking or hunting for that particular device. We advertise on our meter team. We advertise with posters. We advertise by sending out leaflets. which have so far been printed in our own printing department. We have made an arrangement that every permit granted for a new building is to be reported, and the solicitors call on the architect and the builder and the owner who do the work on that building. We have here a past master in this question of selling gas and gas appliances. He is familiarly known by a great many of you as the "Man from Trenton." Excuse me, Mr. Moses, for calling on you so familiarly, but I thought you would not refuse.

Mr. Moses—In our part of New Jersey we sell gas stoves the year round; in fact we have no particular season for gas stoves there. In Trenton, a city of sixty-odd thousand inhabitants, we are selling 18 to 20 stoves a day at present. This is our season. We challenge all comers on gas as a fuel for cooking—everybody, anything. We claim we can cook cheaper with gas than with any other known fuel. We advertise that it is so; and it is so. We advertise the year round, and we sell stoves the year round. The gas stovemen come there with overcoats on to sell me stoves, and they sell a few. I try all means of advertising, and it is pretty hard to tell which is the best, but we keep before the people all the time. The biggest advertisement we put out was in the latter part of August, 1900,

when the season was over for most gas stovemen, but we sold more stoves after August than we did before. We sold in Trenton 2,500 or 2,600 stoves last year. We have orders for 600 or 800 more to be set this season. We are taking orders now for stoves to be set next May, so that they will get them in early. Last year we were 3, 4 or 5 weeks behind in August setting stoves; this year we are setting them early, so that they can have them. We advertise in the daily papers, in street cars, and by any means we can get hold of, more especially with the neighbors. It will be easier to sell 2,000 stoves this year than it was to sell the 2,600 last year, although there are fewer people in need of them. I do not know that I can add anything more, except to say, "Sell stoves."

A Member—What do you sell them at?

Mr. Moses—At very near cost. A stove that costs us $10.25 we sell for even $10—it is so hard to make the change, and we have to sell them so fast.

Mr. Allyn—Has Mr. Moses ever tried selling on the instalment plan.

Mr. Moses—We sell them on most any plan. Last year we sold them on the instalment plan and collected the instalment when we collected the gas bills. We had very little loss. It is surprising. We sell stoves to anybody, and then look them up afterwards. I put stoves into houses, the floors of which were not carpeted; the poorer the people the better the stoves went. Even now you would be surprised. Our biggest output is in the morning. People say they don't use the gas stove in the winter; but they do in the morning, you know. Their coal stove being a little slow in action they get their breakfast on the gas range, because they have to hurry to work. The women folks who work at decorating in the potteries get breakfast on the gas stove and away they go. They cook on the stoves because it is quicker. The women folks get home just in time to make a meal in 3 minutes and don't have to waste time in starting the fire. Our output shows it in the morning, which is the heaviest output in the week days, but on Sunday when the people are at home, they keep the fires going through the daytime to warm the house, and in the morning they use the gas stove. Some gentlemen here tell me that many cooks prefer to use the gas stove because the coal stove is slow. Get

the gas range in and they will use it; put it alongside the coal stove, and the comparison will do the rest.

Mr. Allyn—I see it pays to touch the gentleman up occasionally.

Mr. Moses—Excuse me, I did not answer your question, did I? I was speaking about selling stoves.

Mr. Allyn—Not exactly.

Mr. Moses—This year we are going to sell stoves on the instalment plan. We are selling them for $10 cash, and from $11 to $12 on the instalment plan—$3 down and $1 a month thereafter. We make a difference in the price so that they will pay cash for them. But we will have no difficulty in selling stoves at $10, for cheap selling rates for gas means cheap fuel.

Mr. Allyn—My reason for asking the question was this. We have had no experience whatever in selling on the instalment plan. We have sold directly for cash, and I must say my preference would be for that plan. It would seem to me that, selling on the instalment plan, a good many stoves would come back in a condition which would render it hard to dispose of them at almost any price. That may not be so, but it would seem to me that a great many people might pay one or two instalments and then stop. Then, I suppose, the stove comes back to the gas ccompany. I know when we introduced the Lungren lamps we sold them on the instalment plan, or rather leased them, and after a lamp had been out 5 or 6 months and came back to us no one wanted that lamp installed, but insisted on having new lamps. It may not be so with the gas stove.

Mr. Moses—That is pretty near so, but we take what we call stoves that come back. People make one or two payments and move out of town. It is about the only way we get the stoves back. If they are going to live there they have got to use the gas stove, that is all. But if you get one or two payments on it, when it comes back you can sell it. We clean it, remove the grease stains, tell them it has been used a little while, and sell it for $7 or $8. Some people would take them at that price. You put what you call a second hand stove on the floor with the rest. They are clean and nice, to all appearance just as good as the others—which they are—and if they can save a couple of dollars a great many people will take them. Then occasionally we give a stove away to a church or lodge.

All the churches in our town have stoves. They have an eating room, or something like that—it is getting so that many people now go to church when they think they will get something to eat; oyster suppers and the like. We put stoves in all the fire houses for the firemen to use. The people come in from round the neighborhood and see them in the fire engine houses. The firemen often use them to cook their coffee on, and the neighbors come in and see them. We give them $1 apiece for every stove they sell, and we get out quite a few in that way.

The President—I think Mr. Allyn would find out if he kept a stove shop that, with 1 or 2 payments on a stove, the chances are, by making a slight discount on that stove after it was repaired and cleaned up, he would get out at least whole; and even if he did not get out whole that in the long run it would pay.

Mr. Prichard—In line with the suggestion in the paper I move that the President appoint a committee to look this matter up in the manner outlined by Mr. Humphreys so we may have the benefit of the knowledge contributed by the members.

Mr. Leach—I second that motion with a great deal of pleasure. I think it is a very important matter and should receive the attention suggested by Mr. Humphreys.

The motion having been put and adopted, the President appointed Messrs. C. J. R. Humphreys (Chairman), Wm. McGregor and C. F. Prichard as such Committee. The discussion was then resumed.

Mr. Fowler—Mr. President, you spoke of the Boston Company sending out stoves. Would it be a proper thing to inquire how the charge of losses is made; whether that is put into capital or into the year expenses?

The President—Well, I cannot answer that, as I have not charge of the financial end of the Company, but I should answer from general knowledge that any losses would be charged to expense. Remember, we formerly put out stoves free of charge. We have a great many of those out, and of course they are charged to capital. But if we should sell a stove, any loss made on the stove setting would certainly have to be charged to expense.

Mr. Fowler—And to expense for the year during which the loss was incurred; that is, it is not capitalized from year to year, it is not carried on from year to year?

The President—We have only been selling the stoves for 6 or 8 months, but I presume that would be a mere question of the financial condition of the Company. It might be charged, as suggested by Mr. Humphreys, to expense account, and then charged off as the Company could afford it. In other words, I think it is well to make a special push for business at one time, so as to advertise it thoroughly, rather than fritter away your strength by extending it over a series of years. I agree with Mr. Humphreys in that respect.

On motion of Mr. Allyn, seconded by Col. Richardson, a hearty vote of thanks was tendered to Mr. Humphreys for his paper.

The Association then listened to the following

Report of Committee on President's Address.

The Committee to whom was referred the Address of the President desire to report as follows:

That they commend the address to the members, and suggest that each one read it carefully in the quiet of his own home. Statements are made and ideas advanced that are worthy of thoughtful consideration and investigation. The high pressure burners, and the use of gas engines for producing electricity in isolated plants, are, among other subjects treated in the address, so important that we believe each member can afford to give to them time and thought. One subject, however—and that is the printing in pamphlet or book form of the proceedings of our Association from its organization to the present time—we desire to commend to the special attention of the Association; and in view of the importance of the subject we recommend that the publication of the "Proceedings" of the meetings previous to this one be left with the Directors with power to act.

We also recommend that the Secretary be authorized to print the "Proceedings" of this meeting and distribute same among the members at the earliest possible day. In this way the work will be commenced, and we hope will result in the publication of the "Proceedings" of the previous meetings.

Respectfully submitted,

Charles H. Nettleton,
Horace A. Allyn,
Frederick H. Shelton,
Committee.

Mr. Nettleton—Mr. President, in addition to this I would like to say that this matter of printing the proceedings has come up time and again in the past history of the Association, and every time it has been put off for want of means. It would seem as if the Association had now become so large, and so much interest is felt in it and its meetings, and the papers are so good and the proceedings of so much value, that we ought to have them in condensed form, the same as we would in a pamphlet or a book, instead of being obliged to look through the various issues of the *American Gas Light Journal*. It was with this in mind that the committee, after careful consideration, have made the recommendations that they have.

Mr. W. A. Wood moved that the report of the committee be accepted and that the recommendations contained therein be adopted. The motion was seconded by Mr. Walton Clark.

Mr. Shelton—I want to emphasize the position taken by Mr. Nettleton on this point. It seems to me that this Association is old enough, dignified enough, and of enough weight in the gas world to have its proceedings and literature put on record to as great an extent as the other Associations in this country. Some of the best papers that have ever been presented in the United States have been given on the floor of this Association, and constantly I have found (in trying to look up back papers of the New England Association), a heap of trouble from inability to get hold of a convenient book of reference. It seems to me that if the work were spread over a time (it would be a very considerable expense to print the records of 30 years all at once) that is, undertaken on a systematic plan, by which one or two back years per year were printed and issued concurrently with the current year's volume, the expense would be entirely within the ability of the Association to handle. I believe the work would be sufficiently appreciated by the membership at large to make the members perhaps volunteer to pay a special subscription for that particular purpose. If the Directors should first ascertain the probable cost, the probable time which this extra subscription would have to carry, and make the matter somewhat definite, a circular recommendation might be made, which would be left within their power to act and would avoid any change of the by-laws as to the question of annual dues or anything of that sort. At the same time that suggestion is another plan by which it might be covered. I

think that the dues per year in this Association are the lowest ot any Association in the country, and it seems to me entirely feasible to add a dollar or two a year without being a particular tax on 90 per cent. of the membership, and it would give the Association funds in that direction by which it could broaden the scope of its work and its records.

Mr. F. C. Sherman—As I understand it, we have money enough in the bank to publish these proceedings, and I don't know of any better use to which it can be devoted.

Mr. Wood—I understood that the recommendation of the committee left the matter to our Directors with power. It seems to me they are fully competent to treat the question from the financial and all other sides. I call for the question.

Mr. Allyn—As a member of the committee, I may say we deemed it rather important that perhaps the Association should debate the question a little whether or not the time has not arrived to increase our dues. The dues at present ($3) are lower, I think, than those of any other Association, and I think there is hardly a member who would be unwilling to have the dues increased to $4 or $5, which would give us a sufficient income to meet these little additional expenses which seem to crop out occasionally. I would certainly, before the question is put to the Association, like to hear a more full expression on the part of the members whether they would consider it advisable at this time to increase the dues.

The President—If you will pardon me for expressing myselt on this subject, I think the report of the "Proceedings" should be limited strictly to the "Proceedings," the index, papers and discussions of the "Proceedings." I had yesterday copies of the "Proceedings" for 1881 and 1882, but there was no index. I think an index ought to be added. But I think it ought to be limited to that and that only. Now, I agree with really the originator of this, Mr. Wood, that the matter of publishing the "Proceedings" in the past should be left to the judgment of the Directors. I also do not think that subscriptions for this should be called for by the members. I would like to hear some further discussion, gentlemen.

Mr. Prichard—Mr. President, I want to agree with you on that matter. It does not seem to me necessary to increase the annual dues. We have, if I remember rightly, a permanent fund of some $600 or thereabouts, which originally was $1,000,

and which we succeeded in whittling away by the means of a few lectures. I don't know of any better purpose to which that fund can be applied than the distribution of copies of the past proceedings of this Association among the new members who have not had access to them. I also notice that, in contrast to some 8 or 9 years ago, when the Association was something like $100 in debt at the beginning of each session, we have now on hand, I think, something like $400 in cash, which goes to show that we are going ahead all the time. Now, if we are $400 ahead there and $600 ahead in our permanent fund it does not seem to me it is at all necessary to increase the dues. Personally a great many of us probably would not object to a slight increase in the dues, yet I think there are, undoubtedly a class of members here who might feel it perhaps a little burden; at any rate, they might much rather have the dues kept as they are than increased a couple of dollars. We all know how hard it is to get the smaller gas companies into the Association, and I feel about that as I do about gas stoves, that I would much rather give them the gas stove, or the annual dues, than not to have them here. We don't want to throw any obstacle in the way. Let us sell our gas stoves at cost, if we cannot sell them at that let us give them away.

Mr. Neal—Does this vote contemplate the printing in book form of the records back to the commencement, 30 years ago?

The President—No, sir. The report, as I understand it, is to print this year's "Proceedings," and that the matter of printing previous years' "Proceedings" shall be referred to the Directors with power to act.

Mr. Neal—I have the records of the first meeting that was held, the 2d day of February, 1871. I held the position of Secretary for several years. The record was not kept as it is now. We did not have a short hand reporter, but I kept the record as well as I could myself. In 1870, after the American Gas Light Journal began to be circulated, I had the proceedings as they were printed in the Journal put together, and I lined the columns. There is other matter here, but I drew lines at the columns where any record was made of the proceedings of our Association. That went on for some years. Then Mr. A. B. Slater, of Providence, was kind enough to take shorthand reports of the proceedings of the meetings, and they were more fully recorded. After awhile, we, as you know, employed a

shorthand reporter to take down everything that was done and everything that was said. I have been appointed by you, Mr. President, one of a committee to write some resolutions relating to Mr. Hill, and I have got to look over this very carefully to find out about him. In this first record that I put in this column, taken from the printed reports of the meeting, I find Mr. Hill's name is mentioned quite a number of times, but I have got to look at this record very carefully to ascertain what his connection was and how long with the Association. I am not in favor of increasing the dues unless it is absolutely necessary.

The President — It is understood of course by everyone that the President in his recommendation suggested that the files of the American Gas Light Journal be used as the copy to print proceedings, because in that way we were enabled to take advantage of the work they had already done. Are you ready for the question?

The President then put the motion of Mr. Wood, which was adopted.

On motion, a telegram, expressive of the sympathy of the Association to Mr. A. C. Humphreys, over the great sorrow that had befallen him in the tragic death of his sons, was ordered forwarded.

Mr. Frederick H. Shelton, of Philadelphia, Pa., read the following paper on

How They do Things on the Other Side.

Last summer I had the extreme good fortune to be able to spend a month in Europe. I went for relaxation, with the International Gas Congress and the Paris Exposition as objective points. I am so saturated with gas, however, that I soon found myself poking in an informal way around gas works in foreign countries, to see "How they do things on the other side."

Without pretending to here give you other than a running description of what I saw, I am yet hopeful that such account may be of interest to you, and possibly helpful by reason of comment or suggestion. For ease of understanding I shall refer to all quantities, figures, etc., in the United States equivalents. Unnecessary and general statistics I shall omit, and I trust any seemingly irrelevant remarks or observations, not of

a particularly deep nature, may be regarded as nothing more than jocular pleasantries, to lighten a paper of considerably greater length than first expected.

I visited 7 countries, travelled 3,000 miles outside of the ocean voyages, and saw, successively, as below, 15 gas works, 11 of which were large, 4 of which were small, half city and half private works, and all of which were in the main, I believe, typical and representative. My notes are chiefly relating to plants, the physical features being obvious to the visitor. Matters of policy, efficiencies, and questions outside the works, I often could go but little into, my language abilities being limited to English, and intercourse in French, German, Danish and Dutch, being confined to the reciprocal exchange of cards, cigars, and other evidences of mutual distinguished consideration. In addition to the trip itself, I had the further good fortune to go in the company of Mr. McDonald and Mr. Ramsdell. I need not identify them by initials. There is only one McDonald and but one Ramsdell.

The United States gas man upon reaching England usually makes a bee-line for Beckton, the frontispiece plate in "King's Treatise," and all tradition putting it in mind as the biggest plant in the world, and the first thing to see. So, armed with letters of introduction to Mr. George Livesey, the engineer, and to Mr. Thomas Goulden, both of whom we unfortunately missed, we went there first. To fully appreciate the plant, some figures are necessary. London has about 5,000,000 people, and 11 gas companies, of which the three chief are: The Gas Light and Coke Company, The South Metropolitan and the Commercial. The others are smaller concerns around the edges. The three named, together, put out about 37,350,-000,000 cubic feet per year, have about 600,000 customers, and 80,000 lamp posts. How are those for figures? They make 16½ candle power gas and sell at 64, 72 and 80 cents per 1,000. The largest is the Gas Light and Coke Company, doing 23,465,000,000 feet, or about $\frac{1}{6}$ of all the business in Great Britain per year, and having 360,000 customers. It has 10 plants, of which the Beckton station is the largest. This comprises about 1,000 acres, of which 600 or 700 are occupied, 9 miles below London, on the Thames. The gas made is pumped into the city by ordinary exhausters, through 2 lines of 48 inch main, at from 16 inches to 48 inches pressure. The output in winter of the three named companies is over

200,000,000 per day and of Beckton 50,000,000. This is made in 14 retort houses having 8,404 retorts, about half of which are charged by Foulis's and West's stoking machinery. The plant is operated by from 3,500 to 5,500 men, according to the season. It has 9 holders giving 19,000,000 storage. There are 35,000,000 storage outlying. The stock of coal carried is some 200,000 tons, and of oil about 2,000,000 gallons, for 12 water gas sets that are there. The coal hoisting machinery can discharge 2,000 tons per hour from the steamers at the docks. Upon approaching the plant, the President of the American Gas Light Association and I turned into, apparently, an office, only to find it a workman's beer hall. Getting started afresh—not refreshed—and entering the gates, the first impression is the avenue of 9 holders of all types of the past 30 years. Some with cast iron columns, some with rounded or "whaleback" curbs, all with the sheets without breaking joints (as is the English practice), and one noble structure of 8¾ millions capacity of entirely modern type, 174 feet high and 247 feet across, in brick tank. The very largest holder in the world, of the South Metropolitan Company, of six 30-foot lifts, 300 feet in diameter, and holding 12,158,600 feet, I only saw in the distance, over the roof tops. Around the Beckton premises everywhere are railroad tracks. The Company has a private system in its grounds for handling all materials, comprising 60 to 70 miles of rail, 32 locomotives, several hundred cars, and numerous full-fledged block signal towers. The gas machinery throughout the works is so conventional as to call for no special comment. The work is done by multiplying units. The exhausters and meters are surprisingly small. The latter are some of them built in the square, out-door box form of case, suggesting a mausoleum more than anything else. The purifiers are about 40 feet square, in groups of 8, the houses being of very heavy and expensive construction; the boxes on a middle floor, and the oxide being either raised to an upper, or dropped through into a train of cars on the ground floor, as desired. Among the miscellaneous points noted were four private sewer systems (very necessary with the army of employees), which are worked on the system of converting the waste matter into opposing sets of microbes, which destroy one another, which as Samuel Weller would say, "Is a very convenient way o' doing." Strikes of the workmen—not the microbes—occur at times,

and rather than get in darkness, the London authorities hasten soldiers down to effect order. Barracks for 3,000 men adjoin the works. The boiler plants seemed peculiarly insignificant and cheap. The general appearance of the works' order and condition was only tolerable. The retorts were in sets of 9's. A self-sealing lid of the Holman pattern, without catch, caught our attention as very excellent. The yield of coal gas and general operation did not seem to differ materially from what we get here. Mr. Cossey, one of the engineers, conducted us around, and to him we are under obligation for figures and for the utmost courtesy. Upon leaving, a row of good, old-fashioned New England sunflowers was noticed in a corner of the works—another Anglo-American tie.

NAIRN.—It was a large drop from Beckton to our next point, a little gas works in Nairn, away up in the North of Scotland. But our path was there and the contrast amusing. Nairn is a delightful little residential summer resort, quiet, sleepy town, up among the heather hills on the Firth of Forth, with the rugged hills of Cromarty in the distance. Its characteristics seemed to be ozone, scenery and an absence of anything ever happening. Yet in this little place of 5,000, where the stone houses are, many of them but one story, and with roofs thatched a foot thick, the gas company has 8 or 9 miles of main, 934 customers (of which 220 are slot meters), 300 "cookers" (as they call ranges in England), and puts out nearly 10 million feet yearly. The plant is picturesque and only 80 years old. It has but one 9,000 foot and one 18,000 foot holder, both in the cast iron tanks so common in England, two 9 by 9 purifiers, 4 inch and 6 inch connections around the works, no exhauster and no boiler, I think. Using Scotch shale, a 26 candle gas is made and sold at $1.40 for light and $1 for fuel. The chief detail noted was the use of an astonishingly small size of pipe for meter connections; in some cases a lead or composition pipe scarcely more than a $\frac{1}{4}$ inch bore. This pipe was also frequently noted in Edinboro' and other places, tacked on walls, yards of it, in the weather, feeding outdoor bracket street lamps. Why it doesn't freeze up or stop up, or why so small a pipe should be allowable on any meter is beyond me. The genial manager, Mr. Keillor, had one device, rather clever—an enormous meter index, made with dials a foot in diameter—which he uses for elucidation

purposes with customers, or before an awe-inspired school class of bonnie Scotch lads. In Nairn the practice is to collect bills but three times a year, or every 3, 6 and 3 months. It is a little place, but Mr. Keillor deserves a better plant to work with, for it is certainly doing its share in the 156,665,229,000 feet output of the British Isles.

IVERNESS.—It is not very far from Nairn to Iverness, and while awaiting the boat to go through the beautiful Scotch Lakes, we visited the City Gas Works for an active business centre of 25,000 people. The station impressed us as a very typical average plant, the apparatus throughout seeming to have stepped directly from the pages of the text books and advertisements. The 9 benches are semi-regenerative 8's. The hydraulic was wrought iron, well above the bench. The retort house roof was peculiar in having cast iron rafters, but most attractive by reason of large glass skylights, letting in lots of light in front of the benches, avoiding chilling draughts and broken glass from wall windows. The annular air condensers were out in the yard, very common practice in the English climate. The Beale exhauster was almost identical with our McKenzie. The purifiers were identical with ours, except that the setting is different. They were simply imbedded in the earth with a pavilion roof over them. Such construction cost is far less than our customary building expense, and the arrangement—if somewhat wind-sheltered—seems simple and attractive. The holders 140,000 and 375,000 feet had the usual cast iron tank, in this case imbedded in the ground. Mr. Thomson, the engineer of the plant, reported 75,000,000 sales a year, 3,400 customers, 400 slot meters, 240 "cookers," 26 candle power gas, and price 95 cents per 1,000. A fine chimney stack, 101 feet high, gave draught to the benches and was the pride of the works. They are, as they say over there, very "keen" on stacks, instead of individual chimneys for each bench, as we usually build here. The result is that in approaching an English city one quickly learns to locate the gas works by the tall chimney rather than by the usual gasholders, the chief feature in our landscapes.

PARIS.—The fourth works visited was the Clichy station, the larger of the two plants that I believe supply Paris. The works is a plain, old, large coal gas plant, pure and simple, on first thought surprisingly old and plain, when the size of

the city it supplies ($2\frac{1}{2}$ million) is remembered. It seems, however, that the whole plant is liable to revert to the city in a few years; if this is so, it is not surprising that no money is expended in new or modern equipment. Yet, as in every works, there are several points of interest. The gas exhausters are of the reciprocating piston type, instead of the rotary form universally used with us. And whatever may be said against the Paris plant, the exhauster room must be excepted. Never have I seen an engine room in absolute quietness and smoothness of action, surpassing the Paris room, in spite of 6 engines and exhausters, and numerous connecting, moving parts. But the purifiers! 128 boxes, 8 by 12 each, in rows and battalions, taking 4 houses of 32 each, was someone's idea, once upon a time, of how to arrange things. They look like the unremoved product of a brick making machine! The gas holders are of interest, the columns being neither round, cast, nor built up lattice-pattern, but of plate girder form, uncommon with us. The connections, too, instead of being underground, as with us, were of the flexible, articulated, light wrought iron, external style, connecting the crown of the holder with a stand pipe near by, which is a very common form in France. The retort houses contained benches of 8's back to back, but not through, with Siemen's furnaces and wrought mains. The characteristic of the retort house is the peculiar effect of the workmen wearing their shirts with the tails out, the French blouse seeming very undressed. No stoking machinery is used. The tools when not in use are hung in front of and in line with the retorts on overhead racks and hooks, not left in the way on the floor. The arrangement is simple and excellent. They are very proud of an elaborate conveyor and machinery outfit at the Paris works for handling, measuring, weighing, storing, bagging, etc., coke. An illustrated paper describing it was read at the Gas Congress. It seems to me, though, overdone. I know that while 2 or 3 men were waiting for a lifting machine to slowly raise bags of coke shoulder high, so that they could get underneath them easily, a "gas house tarrier" in the States would in the meanwhile have had his bag half way to where it was wanted, and the men around the apparatus seemed twice as many as in our works. This may have been due to political reasons. The Paris Gas Company goes in somewhat for appliances in the

city show offices, but its price of $1.70 would, seemingly, hinder fuel business. The arrangements for showing the Convention through the plant were exceptionally good, a guide being provided for every 20 visitors, and a brief printed description of the plant and its figures being handed to all.

ZURICH.—What a contrast, however, is the plant at Zurich. After leaving the city, where its sights, the Exposition and the Gas Congress, successfully conspired against any reasonable degree of sleep, we went to the chief city in Switzerland, because everyone said it had the finest existing gas plant in the world; that we surely must see. More than glad were we that we did. The plant is a city works. Zurich lately decided for a new plant. Two years ago this was finished. Gossip says the city paid two prices for it. Perhaps it did, but it surely got "a plant that is a plant." It is not lavish in marble or show, but it is in a space, provision for all features, for growth, and in engineering efficiency. Representing the highest type of German school of gas engineering, it has set a new standard for such works. To describe it adequately here is impossible. To all those interested I would say, get a 28 page book, with 2 plates and 43 illustrations describing it, just published in English, by the English Journal of Gas Lighting, price 60 cents plus postage. I can only here briefly say that in the Zurich works coal is not handled by hand at all. Dropped from the cars, it is first crushed to uniform size, then elevated, stored, fed to retort house bins, charged into and converted to coke in inclined retorts, withdrawn and conveyed to the wagons, or storage bins, all by either machinery or gravity. The retorts number 288, in 4 stacks of 8 benches of 9's each, in a house 500 feet long. The gas, steam, drain, water and pressure pipes pass from house to house in underground conduits. The purifier house, in use two years, looks as clean as when but two weeks from the contractor. The workmen have a house with toilet rooms, lockers, recreation rooms, and even a hospital room, with operating table in case of accident. An electric building houses a plant sufficient for a small town, though used only to light the gas premises. Floors are tiled. Scales on the holder tanks are not painted, but of enamel on steel, weatherproof. An enormous central, iron open-shed houses all yard stuff. Not a thing is permitted to lie around indoors or out. Characteristic of Switzerland is a

4-faced clock in a stone tower, that chimes the quarter hours. The laboratory, pump house, blacksmith shop, ammonia plant, hot water holder tank heaters, and other parts, all evidence completeness of design. Everything for a purpose and everything figured to exact size and balance is most evident, and a tour through the plant is a liberal education in gas engineering. The city of Zurich has a population of over 100,000. The gas plant's connections are of 18 inches and 24 inches size, and its rated daily capacity about 2,000,000 feet, which can be doubled in the future. Don't fail to see it if you get within range of it.

DRESDEN.—With a sigh that no works in America had anything to approach the gas works at Zurich, we proceded to Dresden, Germany, having determined to visit representative works using inclined retorts. We reached that interesting city, after a night on a train wherein they extinguished the Pintsch lanterns by a device that resembles a flannel high hat. The works is municipal. One is first impressed by two large, ornate holder houses of brick, much like the old style of such in large American cities. We were told that an old German law at one time compelled housing holders, it being thought that they were safer that way, confining the effects of a possible explosion. The authorities were poor gas engineers on that point! On the outside of the holder houses we noticed dials with pointers, some 6 feet in diameter, showing the quantity of gas stored, without having to go inside the building, and in fact visible from all over the premises. The works built first with horizontal retorts 4 years ago put in a stack of inclines, and was just adding its second retorts. This well shows the long life of inclined retorts. The operating figures of such I will give later. The 10 purifiers, in a double row of 5, with valve connections, were rather unusual in the symmetrical row of 30 valves down the center aisle. The oxide arrangements were typical of what seems to be the German plan, versus English and American practice. We elevate our purifiers and dump the oxide below. The Germans put the boxes on the ground level and remove the oxide sideways. Instead of shovelling it into chutes they are more apt to shovel it into a hanging tip-bucket, that runs on a trolley on an overhead continuous and sectional track, like a butcher's meat rail.

The buckets are pushed with no appreciable effort, to an adjoining room, the oxide dumped and the buckets refilled and returned around the rail loop to whatever box is being handled. We saw this in Zurich and in several other places. In Dresden a large restaurant was a feature of the plant, where meals are served for a few cents to employees. It seemed strange in a works of such size to note the use of Korting steam jet exhausters instead of the usual piston or rotary form.

BERLIN.—Upon reaching Berlin we found the capital of the German Empire supplied in part by a city works, and in part by the English Imperial Continental Company, private interests operating a number of large works in Vienna, Brussels, Antwerp, etc. We decided to make the works of the latter our visiting point, because of the probable ability to chat in English. Chief Engineer Drory, a veteran gas man, and one of the earliest successful users of inclined retorts, made us most welcome, ably supplemented by two of his assistants. The plant is rather old and outgrown (they are now building a new 42-inch works), but in its long continued and matter of fact use of inclined retorts is most interesting and convincing. We observed there many evidences of the skilled practical management of a private works, and numerous "wrinkles" in detail. For instance, on all bye-passes the stem of the inlet valve is painted black (the metaphor of foulness upon entering apparatus); of the outlet is painted white (significant of purity); and the middle valve, red (significant of danger, or the valve only to be handled under unusual circumstances). We noted also examples of ornamental station meter heads, that our friends across the water are rather given to, scallops and sunbursts and flowers being cast in the pattern in a way that McDonald never does in Albany. In Dresden the meters had Imperial lions and the Royal arms on the fronts. Large street main float governors of the water type were in evidence in this as in other works. Nowhere did we see a compact mercury form to compare with the Connelly as used here.

COPENHAGEN—Tempted by the allurements of a trip by the Vulcan Ship Yards, at Stettin, where the great German trans-atlantic liners are built, by a cozy coastwise steamer on the Baltic, we cut short our stay in Berlin to tuck in a day at Copenhagen. This city of 400,000 is supplied by two works; the old section by the city, the newer part by the Danish Gas

Company, also a parent company, running some 10 works in Denmark and 2 in Germany. Mr. F. D. Marshall, of exceptional ability, enterprise and personal attractiveness, and the general manager, put us under more than ordinary obligations in courtesies extended. His works, built in 7 months, in 1895 (the most practical and efficient that we visited, as regards capital outlay—and symmetrical and sightly), are essentially of the English type in apparatus and design, excepting as to the abandonment of horizontal retorts. None of such for him. His second installation of "slopers" had been completed for about a year, and substantially inclosed in a high, white painted, roomy and airy building. His inclined retort setting for practicability is the best of all we saw, and as clean as our best water gas houses. His design is even better than Zurich in one point, to my mind. At the latter place the overhead coal charging bins, above the inclined retorts, are continuous and very expensive. They cut off much light and ventilation. Mr. Marshall makes his bin, say, but a third the length of his stack of benches and avoids a roof conveyor, saving in expense and gaining in cleanliness and ventilation. It is no trouble to keep it full by vertical conveyor, and the pendant charging buckets underneath, after being filled, are readily pushed hanging from an overhead rail to the particular retort, but a few feet away, that it is desired to charge. The coal storage bins are of trough and inverted pyramid form, constructed on the highly commended Monier system of wire and rods imbedded in cement walls. In the Copenhagen works we saw an anti-naphtaline device, that I at least have never observed in the United States. It is a "sight-feed" so regulated as to put a certain number of drops per hour of methylated spirits into the gas flowing out of the works, the idea being that during the periods of the year when naphthaline troubles are likely, impregnating the gas at the start from the works will make them least likely to materialize. The apparatus is very simple, the liquid being vaporized by steam coil and is almost automatic in action. We also noticed similar arrangements for feeding benzol to the gas to increase candle power, a common plan of procedure on the Continent, where the coals seem to give rather lower candle powers than we are accustomed to. The wooden shoes or sabots of the workmen, and many rabbits around the yard, kept by the workmen, were local characteristics. The most impressive feature at Copenhagen, however, was the statement that 75

per cent. of the company's output is sold for purposes other than light. There is a fuel gas mark for you! Their price is 86 cents for light, 74 cents for fuel, or the option of 80 cents flat by single meter. Station meters with the flanges *internal* were a bit of odd construction noted.

Altona.—Returning during the night, getting on the wrong boat, which would have landed us Heaven knows where, and from which we frantically scuttled ashore just as the hawsers were being cast off, we arrived early next morning in Germany again, at the works of the Altona company, supplying a portion practically of Hamburg. Here we had a good illustration of red tape and discipline. Although driving up in state, with our best manners, most engaging smiles, and pockets full of credentials, the engineers at the works dared not let us in without the sanction of the director general. After a vast amount of parleying and telephoning and driving back and forth to the city office, we finally found that gentleman, who proved courteous to a degree and personally showed us through the plant. Unfortunately, by that time our train arrangements gave us but 20 minutes, and the rate at which we went through the works will probably remain a record and a local tradition for many a day. However, we saw the plant, and a particularly large and commodious works it is. Its feature is the extensive use of hydraulic power. For instance, the box covers, about 24 feet by 27 feet, are mounted each in the center on a vertical hydraulic piston shaft. To raise the cover a lever is pulled and the lid is pushed up 8 or 10 feet, remaining in the air like a huge umbrella, while the box is being cleaned. This hydraulic power of 750 pounds to the inch is also used to operate an elevator that raises and lowers railroad cars bodily between the works' entrance high level and the general lower yard level, in which the tracks symmetrically radiate from a central turn-table. A Gadd & Mason, spiral-guided columnless holder was noted. The inclined retorts there had been in use some four years.

Cassel.—The next day found us in Cassel, a German city of 100,000 population, but of no interest to the tourist excepting for a king's palace near by. That we should prefer to go to the gas works undermined the hotel porter's idea of the fitness of things, most sadly. Reaching the works (also a city plant), by the most up-to-date American trolley line that we saw, and

which contrasted curiously with the narrow, picturesque German streets, we found a warm welcome by Herr Mertz, the director, a typical coal gas works, and inclined retorts. In this works we noticed an electric plant, run by gas engines, for lighting the works; and a briquette machine, occupying such a small space, and being so simple in its operation of turning out fuel bricks from tar and breeze compressed, that we wondered why we do not do more of that sort of thing on this side. We also noticed an excellent purifier house, the feature of which was the center-seal in an isolated, sealed off annex, on one side of the building. The feature that has most remained in mind, however, was a marvelous locomotive without firebox, with a boiler of 3 cubic meters or about 108 feet capacity (so well insulated that it was practically cold to the hand), that gets a charge of high pressure steam in the morning, at say 80 or 100 pounds, and then works on that charge all day, shifting cars or standing around as the case may be, without recharging. We expressed surprise at this and asked Herr Mertz about it again in about 4 different ways, as to the fact, but he seemingly understood the question and stuck to it that that's what the fireless locomotive does.

ROTTERDAM.—From Cassel we journeyed to Rotterdam, via Cologne, without incident, excepting the most remarkable fact of the best hotel in the latter city, chasing a porter after us to the train, to collect 12 cents, the price of 2 boiled eggs, that had been left off the bill. I imagine Young's or the Touraine doing that! The Rotterdam works, a private plant, are essentially "early English," very conventional, and of far less interest to us than the city itself. The benches are horizontals, old and inefficient. Inclined retorts are about to go in, to replace them. The 18 purifiers (about 24 feet square each) were reminiscent almost of Paris, and the wheelbarrow arrangement for oxide as crude as could be; yet burlap curtains tacked on the boards that are laid over the cups—while filling—to keep the paint clean on the sides, was a clever thought. The most elaborate feature, and one that caught McDonald's eye, was the pretentious meter room. The two 12-foot Parkinson meters had most ornate case fronts, and were mounted on heavy bases of beautifully polished red Scotch granite, which bases were surrounded by mosaic flooring and tile wainscoting. This meter room, and the enormous Dutch wind-mills near by—operating

by a power unassailable by gas engines—linger well in our memories, together with the courtesy of Mr. Sisson, assistant director, and his bright young Dutch assistant.

THE HAGUE.—In Holland's capital, we visited the city gas works and found the chief point of interest to be the fact that, after using horizontal retorts and the best stoking machinery, and comparing such working with a stack of "slopers" alongside and under identical conditions, the management has elected for the inclines hereafter. The general plant is rather cut up, built piecemeal and entirely conventional. In the meter room we noticed one of the station meters frequently seen on the Continent, wherein the usual index of a string of dials is replaced by mechanism similar to the counting machines that we often see on pumping plants, to tally the strokes. That is, a straight row of figures in a box, that change one by one, and of which no figures show but the exact ones for the current meter reading. A large plan of the works under glass, showing all pipe, connections, valves, etc., in the exhauster room for the guidance of the workmen, was a very practical feature.

AMSTERDAM.—In this city, where the plumbers' signs read "Steam, water, gas and beer piping done here," we visited the large and architecturally, unusually fine plant, lately sold by the Imperial Continental Association to the city, built 17 years ago. It also is conventionally English, has no stoking machinery, no conveyors, and in but few ways is comparable with the modern plants, either English or German. A point striking us amiss was that, though surrounded by canals, the works yet provided no way to get coal by water. In common with all such plants it has a considerable ammonia department. In addition I saw for the first time the commercial saving and working up of cyanide. After the gas has been condensed, washed and scrubbed, and before it enters the purifiers, it passes through, practically, a second rotary scrubber of the well known standard washer type, which, instead of being operated with water, as it would be, to absorb ammonia, is operated with such a liquid as will chemically absorb the cyanide base. The resulting liquor is later treated and distilled, and the cyanide product precipitated and collected in crystals on long strings. It looks exactly like yellow "rock candy." It is shipped, broken, in barrels, to London, for the South African gold mining market, and brings about 15 cents per pound. The process seemed fairly

simple and easy for a works of size maintaining a chemist. Amsterdam is about to contract for what was stated would be the largest holder on the Continent—some 5,000,000 capacity, in steel tank, and this tank is to be built hollow, and to be used as a store room; something that has been done in a few instances abroad. That is, the bottom of the steel tank, instead of being flat is to be dome shaped, rising almost to the water level, yet giving around the sides the full water legs and depth. Lit by electricity inside and with a depressed entrance, the claim is that such storage room so secured costs no more than a building would built elsewhere, and much ground space is saved. In all the Holland plants visited, where the streets are below sea level in the old see bed protected by dykes, the street mains are laid on piles, one to a length under each bell, to prevent indefinite settling.

OSTEND.—Tiring of seeing mostly large works, I made a detour, resolving to visit Ostend (a watering place on the English channal), Belgium, of some 30,000 to 40,000. I must confess that I did not see much. The plant is old, of poor design, illy kept up, and has no features other than 4 benches of 11's in each arch, the largest number I have personally seen. Making from 250,000 to 500,000 cubic feet per day, they yet felt it would pay to have— and they had—a conveyor system for removing coke. A very odd bit was 2 steel holder tanks in which the top rows each of plates were of cast iron. The proverbial politeness of the French (and Belgium is, essentially, French), was illustrated by a stray complaint postal card that I chanced to pick up, in which Monsieur, a consumer, requested the director to send to him on Tuesday morning a workman to remedy an escape of gas. He closed with his "distinguished salutation." How many of our customers are as polite when complaining about a gas leak?

SALISBURY.—The last, and the 15th, works visited was back in our first love, England, in that beautiful old English town of cathedrals, and second-hand and antique shops, where they trap the unwary American dollar, and of Mr. N. H. Humphreys, who writes the English letters to the American Gas Light Journal, and in whose courtesies I am a debtor. Salisbury is a place of 18,000. The gas works, barring minor details, is practically what we find in our own country for coal gas plants of similar size, excepting expected differences in details and

construction, and a device not seen before, by which if a workman should, inadvertently, in changing valves, shut off the town, live gas from the inlet to the holders is automatically switched into the mains. The feature that impressed me the most though at Salisbury is the amount of business they do. With 18 or 19 miles of mains, they have 500 city lamps, 2,000 meters, 650 cookers, and sell 100,000,000 feet per year, or 50,000 feet per meter. Mind you, the town is under 20,000. The candle power is 16. The price 84 cents. Slot meters, about 150. The output at large in England runs 2 and 3 times ours.

Salisbury is an excellent instance of it. I attribute it to these several reasons. The gas companies are protected from competition by Parliamentary Act. They quit unnecessary opposition companies 25 years ago over there. We are still in that stage. Therefore, they can reach selling prices that we cannot. English companies, moreover, have been in business 40 and 80 years, where our companies are but 20 and 40 years old. Hence by this time the English companies, in business twice as long, have their towns practically completely piped, and their customers far more educated to the many uses of gas. The resulting volumes of sales facilitates lowering of prices, and this in turn enables gas to be freely used in heaters as well as cookers; and the English climate is more amenable to an impression being made on it by gas heaters than is ours. In brief I do not believe that other than protection and long years at it are the reasons for the larger English sales. It is not cheaper coal and labor. Such are not cheaper. Their operating costs seem to me cheaper only in so far as the benefit extends of larger quantity made.

Let me now summarize what I saw in inclined retorts on the Continent. The universal setting was in 9's. The firing generators were both internal and external. The earlier length of retort of about 12 feet has been almost uniformly changed to 15 or 16 feet as the right length; that is. in Germany where the development is highest and a settled standard has, seemingly, been reached. The general time of charge is 5 per day, or 4¾ hours per charge. The charges in weight run 650 to 700 pounds of coal. The yield per pound is about the same as in horizontals. Per 15½ feet retort in Berlin it was about 14,400 to 14,750 feet per day, or 130,000 per bench of 9's. All of the fuel being taken in by conveyors, and the coke taken

out mostly by machinery, the retort house labor runs from four-fifths of a man to one man per bench of 9's per shift. Drawing and recharging averaged from $2\frac{1}{2}$ to 3 minutes per retort. The carbonization generally was perfect. I can say no more; the charges were practically, universally, completely burned off, and the coke ran out as freely as the promoters claim for it. The life of the retorts is about 4 years or 1,500 days. We found the above facts beyond reasonable doubt; we saw inclined retorts in great numbers, in Zurich, Dresden, Berlin, Copenhagen, Hamburg, Cassel and The Hague, 7 places in 4 countries, and the universal verdict was the same, viz.: That they were the only thing to use. Half of the places were laying down, as they say, additional installations; all after comparing with horizontals, several after 4 years' trial of the first equipments, and one after side-by-side test with stoking machinery. Zurich, the finest plant in the world, is entirely inclines. So is the Imperial Continental's new Berlin 42-inch works.

After such evidence there is no possible doubt left in my mind as to the satisfactory working of "slopers," or as to their being the coming apparatus for works of considerable size. In this country there is practically nothing as yet in inclined retorts. Two plants only have just been started. They will grow fast though, I believe. England is doing something in them, having numerous installations and a strong faction advocating them and trying to agree on details. Germany has made up its mind both as to what it wants and how to build it and is far in advance on the question. I saw no gas works in France except in Paris, and conversed with but few French engineers and can therefore express no opinion as to the status of the French on the question.

Outside of inclined retorts, and speaking entirely in a general way, there is no material difference in the best American, versus the best foreign gas practice. Benches, stoking machinery, condensers, scrubbers and washers are practically identical. On the Continent, however, the P. & A. condenser is used to a much greater extent than with us. The McKenzie and Beale exhausters are almost identical. I saw, however, no exhauster of the 2-blade Root type, although I presume they can be found. Purifiers are identical, excepting as to locations. We invariably house and usually shift oxide up and down to different levels; the English work on the 2 stage plan also, in

most new work, but often go out of doors. The Germans house, but shift oxide sideways, as stated. Station meters in the main are identical, except as to ornateness. In gasholders England leads us in size and in the breaking away from tradition; some 75 of the Pease, wire rope guided, and a number I believe of the Gadd & Mason spiral guided, columnless holders having been constructed. The 6-lift 12-million holder already mentioned is also on plans by which the two top sections, when inflated, rise entirely clear of the framing. Distribution practice, mains and details are almost identical. I saw no sign of high pressure workings on the lines that I have recently inaugurated, but such plan of operating was viewed with, I think, more than passing interest in view of its potential possibilities. Consumers' meters are of the universal type, but a very heavy proportion of wet meters are still used in England. Prepayment meters are a staple and in use in great numbers. Labor questions trouble our English friends far more than here. The general plan is 8-hour shifts. The pay at Beckon is $1.38, equal to $2.07 for our 12-hour shifts. The stokers, machinists, brick masons and endless other unions have always to be reckoned with. The superintendents generally seem to get distinctly less pay than with us. Free rent, coke, light and taxes often are included, however, and with cheaper costs of living in some respects, the difference may be more apparent than real. The superintendent is frequently, however, required to live and bring up his family at the works, and my general thought is that the superintendents in America average better pay and greater freedom. Boards of directors, who are at times a hindrance, and the cumbersome efforts of public authorities seem to bother the earnest managers there as much as here. While I do not rank English talent higher than that here, there are undoubtedly numerically many more thorough and skilled gas engineers there than here. The general average of cleanliness, fresh paint and condition, I am sorry to say, in England seemed to outrank ours.

England seems far freer from the "patent process" promoters than here. The higher price of oil probably hinders turning out new schemes so often based on a new form of oil distilling apparatus, and the Parliamentary Acts prevent the ready "opposition franchise" plan of floating new gas schemes. Legitimate water gas plants (in which the lead is easily held

by our countrymen, Humphreys & Glasgow) seem to be put in more and more every year, not to displace coal gas, but to co-operate with it, for fluctuations of output, labor questions, enriching, convenience, etc. At present the history of the Loomis system (which you will remember was heavily installed in this country 5 to 10 years ago, but which has almost entirely died out since), is apparently over there being repeated by the Delwik-Fleischer, a system of blue, fuel water gas, which a number of iron working establishments have installed, and which the promoters, as usual, claim is the only way in which the regular gas companies should hereafter manufacture. Gas engines are far more used than with us, especially in gas works. We constantly saw them operating coke crushers, conveyors, etc. The English gas cookers as a rule are much heavier, plainer and more expensive than ours. It is claimed by some that the more lasting grade pays, especially if a rental business is conducted to any extent as is often the case. Some of their stoves are enamelled and in colors, to prevent rusting. Readily wiped off with a damp cloth they are very attractive and even ornamental. Gas companies abroad run on low candle powers. The South Metropolitan, of London, I believe has recently been authorized to go from 16 to 14. Welsbach burners are almost universal. The disappearance of open flame is, seemingly, complete, and the use of mantle burners on the Continent particularly, for lamp posts, is very general. Lamp posts proper are more varied and more generally ornamental than here. The Gas Light Journals abroad are better than here. More enterprise and more technical talent are manifest in their productions than in our home papers. A part of the reason probably is a larger field justifying greater expense.

To the International Gas Congress I shall make no special reference. An American report upon it I believe will shortly appear. The English Journal of Gas Lighting published an excellent resumé of it, which, re-printed by the American Gas Light Journal, can be found in its issue of October 1, 1900, page 523.

The Congress was much like other gas conventions, but rather larger than our principal American ones. It was seriously handicapped by the mixture of languages. A man would read a paper in one language and a delegate afterwards

would talk vigorously about it in another, while the author, wondering whether his argument was being attacked or commended, was quite unable to either grasp or answer the comments made. Distinguished presidents, secretaries and officials were so thick as to be common, and there was a vast amount of mutual admiration and felicitation by the honorables, of whom 20 or 30 were always on the platform, looking their most distinguished. The occasion as a whole was most enjoyable. The French Society were admirable hosts, and no delegate failed to appreciate or will ever forget the courtesies extended. The papers presented, as a rule, were of exceptional character in reflecting the present state of the art, and will well repay a systematic reading in the translations.

In conclusion, let me here again express my thanks for the continued courtesies extended throughout by many new friends met and made on the common platform of love of our profession, irrespective of the side of the Atlantic we chance to be. And to any of you who get an opportunity to visit foreign works let me say to you, do so; for every minute will be of the keenest interest.

Discussion.

The President — Gentlemen, if I thought it comported with the dignity of the President of the Association, I would say that that was a "bully" paper. It is before you open for discussion. Will Mr. Ramsdell tell us something of what he saw while on the other side?

Mr. Ramsdell — I don't think I can add anything. The paper is exceedingly able and complete, and it seems like a panorama as I sat here and heard it. Mr. Shelton has covered all the ground. I would have to get my notebook to find any spot that he missed. I indorse the paper very fully, although on one point I think I differ with Mr. Shelton. He is a little more enthusiastic on the inclined question than I am. I came back here, perhaps fully as enthusiastic as he, I have done a good deal of figuring since then and believe that I have changed my opinion somewhat, owing to the greater expense of installation. I am not prepared to talk positively on this, for I have not brought any figures with me, not knowing that this was coming up; but I must say I have weakened a little. I don't say that I am entirely transposed or anything of that

kind. I fully agree with Mr. Shelton that there is no question whatever but that the inclines work satisfactorily. But you will notice, even in the figures Mr. Shelton quoted there, that in a 16-foot retort they were not getting as much gas proportionately per foot of retort as they would in a horizontal retort of 9 feet, and the same is true in other directions. It is purely a question of cost and of local conditions. Certain works in my judgment will be better equipped for inclines than for anything else; but, on the whole, Mr. Shelton has certainly done the honors of the occasion in very fine shape.

The Secretary — I would like to ask one question. Perhaps it was covered, but, as usual, I was not attending to business. It relates to the ground space. In your figures did you take that into consideration, as adding to the desirability of the inclines, for instance, where room is scarce?

The President — Excuse me. I desire to call the Secretary to order. The subject before us is the general paper, and we are going to discuss that just a few minutes. If the Secretary will wait those matters may be brought out in the discussion on another paper that we are to have shortly. I think Mr. McDonald was also in Europe. Why have we not heard anything from him?

Mr. McDonald — I have listened with a great deal of pleasure to Mr. Shelton's paper. I think, however, that a great deal of the credit for the knowledge that Mr. Shelton and Mr. Ramsdell have on the subject of gas works and inclined retorts is due to my action while in Europe. (Laughter and applause). I cannot attempt to add to the fund of information that they have produced here today. With yourselves, I acknowledge it is great. The only thing that I don't vouch for, and which I did not see was the engine that went without fire. My particular province while these gentlemen were in Europe was to prepare them for their work, and to take care of them after they were through with it; and I don't think they can say I ever failed to have something for them to eat when they were tired, or to drink when they were exhausted. Therefore, I feel that I am entitled to a great deal of credit for having produced here today such a paper as this is on the gas works of Europe. (Laughter).

Mr. Shelton — Any figures that may be wrong I will therefore say were entirely the result of Mr. McDonald.

Mr. McDonald — I would, however, as a gas man, like to add my word to what has been said about inclined retorts. I was greatly impressed with them. I saw a great deal of them and became fully impressed with the fact that they were the coming thing; at least as far as the Germans are concerned they have made up their minds. Knowing what they wanted, as Mr. Shelton says, they are going ahead with inclined retorts without any more talk about it. Since reaching home I have had the pleasure of seeing the operation of the inclined retorts in the works of the Louisville (Ky.) Company. I think I said to 1 or 2 gentlemen here that I thought they worked better than any I had seen in Europe. They certainly work beautifully. No attempt was made at machinery to handle the coke, but the coal was handle in the usual way, with the use of a pocket, as we saw in many places in Europe, and very successfully. I think it is worth while for the gentlemen to look up the matter of inclined retorts for large works.

The President—In announcing the close of the discussion on Mr. Shelton's paper let me say it was a very happy sequence that his paper followed Mr. Humphreys'. Mr. Shelton, I will not move a vote of thanks to you. Everyone's face, and laughter brought forth, show you how much they appreciated it.

Mr. Shelton—The laughter may be a questionable compliment.

The President—Well, it was reminiscent to some extent, as well as the serious part, so I think you ought to be gratified with that portion of it.

Mr. Shelton—Thank you, gentlemen.

Inclined Retorts and Other Matters.

The President—The next questions to come before us include inclined and horizontal retorts, and later and finally coke ovens. It has been arranged that special cars will be in waiting at Post Office Square, only a block and a half away from Young's Hotel, at about half past 1. We expect to adjourn in time for all to get a hasty lunch, but through the courtesy of the New England Gas and Coke Company there will be a few sandwiches and cold water, I believe, at the works, so that if anyone fails to get sufficient to carry him through the long trip through the works he can there have a bite to eat. They also have volunteered to defray the expenses of the special cars, but I have

told them that the Association, while appreciating their courtesy, would prefer to supply their own conveyance, as they have in the past. Now, gentlemen, we will open the question of inclines and horizontals by calling on Mr. Egner, who I think has a few words to say in reference thereto.

Mr. Egner's Remarks on Inclined Retorts.

Mr. Egner—Mr. President and Gentlemen, when I came to Boston I did not expect to find a meeting so much inclined to inclined retorts, but the reading of Mr. Shelton's paper reminds me largely of something that was said about me once upon a time, about 17 years ago, at St. Louis. We had a retort house strike there then, and when we got through it a neighboring saloon keeper said, "That fellow is luckier than a Chicago baseball player." I did not expect to have a paper preceding me which spoke so favorably of a thing which I have been so many years actively engaged to bring before the American gas profession, as many of you know. Mr. Egner then read as follows:

You have kindly asked me if I could contribute something about inclined retorts up to date, particularly regarding the Louisville installation. As to the latter, having learned that some members of the New England Association of Gas Engineers had visited Louisville at a much more recent date than I, these gentlemen are in a better position to give the very latest information upon that portion of the subject, and it is to be hoped that they will favor us with the results of their investigation. I have not seen the Louisville benches since August last, when they had been only in action a couple of weeks; but at that date the engineer of the company, and also the president, expressed themselves as confident that they had made no mistake by the introduction of the inclined retort system. I was informed then that the men employed in handling the new benches were men who had no previous retort house experience, and it did not require much personal retort house experience to see this without any special assurance on the part of anybody. The weather was extremely hot; and this, taken along with green men to operate a system which was in a measure also a new thing to the executive officers of the company, was certainly a trying situation, which nevertheless was of a nature

not discouraging to the officers of the company, as their expressed opinions indicated. Little details of operation not before understood, were pluckily, and, of course, intelligently, met by the engineer of the company, Mr. A. H. Barret, who, as you all know, read a paper describing his benches at the last meeting of the American Gas Light Association at Denver. To that description I would now refer you, along with the statements of your own members who have seen these benches, as I stated, at a much later date than the writer. The inclined retort system is now no longer one of these things which *may be* successful; it no longer requires argument to prove its practicability and economic utility. This success does not even depend upon the outcome of the Brooklyn or Louisville "experiments," if we will still call these installations such; although I think the engineers of said works do not so regard them. I am glad to be able to say that there are American gas engineers who believe that anything which can be done in Europe can be done as well, if not a great deal better, here in this country; and who have expressed themselves to the effect that they are going to have inclined retort benches anyhow, no matter what the result at the two works mentioned may be.

Having become convinced that benches with retorts set at a suitable angle, to enable us to take advantage of the law of gravitation in operating them, can be substantially constructed, and at comparatively no greater cost than horizontal retort benches, that the cost for repairs is rather less than greater with the inclines, and that the yield and quality of gas and byproducts obtained are about alike with same coal, we have this certain advantage with the inclines; that the greater simplicity and ease of operating a coal gas works by means of them enable us to realize such a material economy in cost of manufacture, that, unless there are very good reasons for it in other respects, a gas company cannot afford to disregard the advantages presented by the inclined retort system. The engineer and manager of a large gas works in Switzerland, where only inclined retorts are used, expressed himself in the following words as to final results, to his colleagues at the latest meeting of the General Association of German Gas and Water Engineers:

Results When Using Inclined Retorts.

1. "Entire independence from the caprice or good will of the workmen in conducting operations. During epidemics, war or strikes, one can conduct the largest works with a handful of inexperienced men.

2. "Simplifying operations, and, with greater security in operating, increased power of production.

3. "Reduction of the number of men required, together with a reduction of labor required per man employed. By these means the periods of rest of the laboring man are lengthened, as during a working day he will be required to actually work only 5½ hours."

The engineer quoted from is Herr A. Weiss, of Zurich, in his address delivered by invitation of his associates upon the occasion previously mentioned. Herr Weiss also gives the following "pointer" : "Gas works with a minimum production of 106,000 cubic feet per diem can engage with profit in the employment of mechanical coal and coke handling apparatus."

Our old friend, or so he seems to be to many of us, Mr. Thomas Newbigging, of Manchester, England, expresses himself as follows in an article reviewing "The Progress of Gas Enterprise from its Inception down to the Present Time:" "It appears to us that important developments in carbonization are attainable; one can almost discern their coming." The inclined system of retort settings, with its labor saving and other advantages, will grow in favor year by year. He prefixes his remarks from which this quotation is taken by the words "Pointing the Way," and concludes them by mentioning some of the drawbacks to that system in existing retort houses, and how these might be overcome. The article was published by the American Gas Light Journal, and taken originally from the Gas World. Members of this Association have gone to Europe and there have seen the inclined retort system in operation, so we do not have to depend on what we may see in this country to guide us; but for all that the gentlemen who had the foresight and courage to be the first to here introduce the system deserve our applause; and the foreign engineers who have done so much to improve the original Coze system certainly are entitled to credit for their labors. But we ought to remember that the successful operation of not

only horizontal but inclined retorts as well, requires intelligent care of the heating and generating apparatus employed. I have in the last years frequently met superintendents who remarked that the old fashioned retort house fireman was getting to be a rare thing; and have observed that patching, or better let us say, "protecting," retorts seem to be one of the lost arts. As to the typical stoker, the inclined system enables us to dispense with him; but not so with the sensible, intelligent, care taking of the retort bench. Twenty years ago fireclay retorts were not as well made as now, and yet we hear more complaints now than then on account of the quality of the retorts. Please understand me to speak entirely as a gas engineer, not as one who is from necessity and not from choice now in the ranks of that honorable body which we distinguish as "The kindred industries." What I say in relation to the care of retort benches is entirely based upon my experience as a practicing gas man. In the days before water gas was known it was no uncommon thing for the retort house foreman to put a new side, bottom or back into a retort, and holes the size of a man's hat in the roof of a retort were mended between changes occasionally without the matter being thought worth while to report to the superintendent. Retorts being all hand made, and built up piecemeal, were more liable to having pieces drop out of them, and that, too, when no such heats as now are thought to be desired were in vogue. It is not so very long ago after all, and one need but recall the facts to have many of you present recognize them. But at the present day, when experience counts for nothing in many quarters, and great sums of money are sometimes wasted for want of it, by preferring "young blood" in the business which, excepting that of the naval engineer, requires greater versatility on part of the gas manager than any other branch of civil engineering, incidents like the following are not uncommon. Upon making an inspection of the retort house in which new benches were being prepared for the first charging, cracks were shown me in the new retorts with the intimation that they were faulty in material or make.

I had visited that plant the previous evening, and judged from the color of the retorts that they ought to have a charge of coal right then. The following morning I was there pretty early, and found that not only had these retorts not been charged,

but in two of the benches, heated by full depth, regenerative furnaces, the fire in the latter had been allowed to burn down so low that the grate bars were visible from the charging floor above, when the cap or door on top of the furnace was removed. And that happened not once, but again the next morning. I was not in a position to speak, but could scarcely refrain, especially as the engineer of the company I respected highly and esteemed as a friend. At the same works I saw on another occasion the primary and secondary air shutters adjusted, or I ought to say disarranged, in such a way that, with a fuel chamber full of coke, it would not have surprised me to have found the retorts and settings burned down the next morning, for that there is a limit to the resistance of the very best fireclay material we all, of course, know. The lesson to be learned from such an occurrence is one which no doubt none of you need to be told—viz.: To have at least one of the men on each shift in the retort house made responsible for the condition of the bench; and let him understand that you know that all faults are not to be laid at the doors of the retort manufacturer, if, by ignorance, laziness or downright carelessness, such a valuable piece of apparatus as a retort bench is injured, perhaps ruined. Retorts, during the first firing up, may develop small cracks; and after scurfing they are sure to do so. Then, a little retort cement skillfully applied will save the retort, and often make it do another whole season.

The operation of scurfing ought always to be closely watched, for it is something like the measles with a child, dangerous to the very life of the patient, but innocent, though annoying, when proper care is taken. With the inclined retort scurfing is a simple operation, and the retorts do not gather carbon as quickly either as with horizontal settings. Finally, I have been asked an opinion as to the relative merits of the inclined retort system and by-product coke ovens as related to the gas industry. It appears to the writer that, like the relation of water gas was years ago, so is the by-product coke oven system to the gas industry of today; simply a matter of dollars and cents, and which, with the authenticated results already in our possession or at our command, can be reasonably decided without taking any chances whatever, by those so situated as to make a comparition of the two systems desirable. But as to the inclined retort system, compared with the horizontal retort setting, there

seems to the writer but one verdict possible. And that is, the inclined setting of coal gas retorts is the most valuable improvement in gas manufacture brought out within the past 10 years, not, however, forgetting the automatic handling of coal and coke, which go hand in hand with it, but which are not essential to obtaining the advantages of the inclined retort system. And with this final verdict on the writer's part, he will leave the subject in your hands.

Discussion.

The President—We are all gratified that Mr. Egner has contributed this to the general discussion. Is Mr. Ramsdell still in the room? Mr. Ramsdell has already perhaps expressed himself as far as he desires to in connection with Mr. Shelton's paper. I say this, so that the discussion may refer back to Mr. Shelton's paper.

Mr. Ramsdell was not present.

The Secretary—A point I would like to bring out was whether Mr. Ramsdell, in his reference to figuring out the dollars and cents, had taken into account the relative ground space as advantage on the side of the inclines.

The President—Well, Mr. Secretary, if Mr. Ramsdell does not come into the room we will ask him to answer that question for our "Proceedings."

Mr. Walton Clark—Perhaps Mr. Egner can tell the relative amount of floor space in the retort house per 1,000 feet made.

Mr. Egner—I can, Mr. President. Floor space requires very much less than with horizontal-retorts. For instance, inclined retorts 20 feet on a slope will require about 16 feet and some inches floor space. Now, these were 10-foot through retorts, that would occupy 20 feet. So instead of 20 feet they occupy more than 3 feet less as floor space. And so it goes on from 20 foot retorts down. The space required is less.

Mr. Walton Clark—Mr. President, I would like to ask Mr. Egner how much space is saved by the adoption of inclines in place of machine charged retorts. There must be something saved between the bench and the wall. The point I want to get at is what is the relative floor space of the retort house for a given make of gas.

Mr. Egner—I am very much obliged to you for asking that. It lies a great deal with the man who puts in the works. For the floor space actually required you might give say 10 to 12 feet in the back or the charging end, and say about 14 to 15 feet on the discharging end; this would be ample floor space. For the same capacity you may safely count on saving 10 feet at least, in the width of the retort house. Should inclined retort benches be erected back-to-back as, for example, at Louisville, then 25 feet space between the benches is not too much; even a little more would make the house more comfortable in summer time. Whenever the ground will admit it, and the comfort of the men is considered as it should be, it will be better to have the benches in a single row. Inclined benches thus constructed are even then the same in effect as horizontal retorts back-to-back, because the inclined retorts are as a rule twice as long as the horizontals, though occupying less floor space.

The President—The Secretary will put that question to Mr. Ramsdell now as well, Mr. Ramsdell having returned.

The Secretary—The question was whether in your statement in regard to figuring the comparative cost you had estimated the advantage on the side of inclines of decreased floor space.

Mr. Ramsdell—Of decreased what?

The Secretary—Floor space required per unit of production, with the inclines as against horizontals.

Mr. Ramsdell—I don't know that I have estimated just the way you are putting it. I have estimated on the interest on the entire investment, if that is what you mean. Of course, they take up less floor space; there is no question about that, per bench. None of the installations we visited on the other side were arranged as the Louisville benches are. It seems to me their working floor space is too small. I have not been there, so I am talking on general principles; but I would think that the stage floor, or the working floor, which if I am informed correctly is 15 feet, would be too limited. I should say that that ought to be at least 20 feet, on account of ventilation and the comfort of the men.

Mr. Oscar B. Weber—Mr. President, I would like to answer the question. The floor space on inclines is just as much as the floor space on horizontals. It occurs in the character of

the installation. You have a flue in the back, and that flue more than makes up what the incline saves for you in floor space, so that practically per unit of retort area you have to have as much area as on the ordinary installation, just as much, if not more.

Mr. Egner—Mr. President, I am very sorry that I am obliged to flatly contradict Mr. Weber; but I do it. He speaks according to his experience and no doubt believes what he says—I will say that; but I assert absolutely that he is entirely mistaken. I know it, and so do the other gentlemen who have seen the inclined retorts on exhibition.

The President—The time has gotton so short that I have taken upon myself to ask the stenographer to go over to the New England Gas and Coke Works with us. Dr. Schniewind will commence a portion of his paper, and if he has anything further that he cannot say in the time we have at disposal, why the stenographer will take it over at the works. I say this now so that, if the two gentlemen who have spoken last desire pistols and coffee, they will have an opportunity there, and the stenographer present. Now, if we could hear from Mr. Prichard in regard to this matter.

Mr. Prichard—Mr. President, there is nothing that I can say from actual experience. The last few months I have been looking up the matter of inclines with the intention of putting some in. At the next February meeting, I hope I shall have the pleasure of showing you some in operation. I am satisfied that is the proper thing to do, and believe most of us can derive profit. It seems to me, as I look the matter up, most of us are paying about 9 cents per 1,000 for retort house labor, and that we are facing now the 8-hour question. If an amount of gas can be got out of a bench, with the labor indicated in Mr. Shelton's paper, for instance—that is, 135,000 or in that vicinity per man—you get down to a couple of cents per 1,000. If it can be done for 4 cents, and I make a saving of 5 cents on my labor, I ought to be satisfied. In relation to the floor space taken up, I had planned roughly—of course, with a possibility of changing—that, our present retort house being 60 feet on the outside, the new retort house could be 45 to 50 on the outside. I may be wrong in that, but expect to land about in that vicinity. Mr. Weber brought up the question of the flue. It seems to me that Mr. Weber possibly overlooked the fact

that the flue is beneath the working floor; although the distance from the front of the bench to the extreme outside of the flue might be as much or more in the present retort house, yet that flue can be put under the working floor and the 16 feet that Mr. Egner Egner speaks of still hold good.

Mr. F. C. Sherman — I had the pleasure of visiting the Louisville works during the past three weeks and can confirm all the statements which Mr. Barret made in his paper read at the Denver (Col.) meeting. The chief point of interest to me was the great saving of labor accomplished in the use of the inclined retorts at the Louisville works. I found that per man there was handled 9 net tons of coal against 2½ tons at our works in New Haven. Now, the gentlemen here present can make their own figures on that. It figures out in my case that, while the labor in New Haven costs, say, 8 cents per 1,000, he is paying 26 cents; or, in another way of putting it, against 80 cents a ton in New Haven for handling coal he is paying 26 cents. All the other results obtained there are essentially as obtained in horizontal settings. He gets a yield of 4.80 per pound, and the candle power is the same as with the horizontal retorts. He uses a cheaper quality of coal. He mixes 25 per cent. nuts and screenings with his unscreened coal, which comes from Pittsburg, and make a saving in that direction. His coal is handled entirely by machinery, and so is the coke, so that there is very little labor. The only labor that I saw about the place in the coal department was wheeling the coal to the breaker. Four men take care of 9 retorts, two on the charging department and two at the discharging; they take care of 9 retorts every hour, and he is running 5-hour charges. You see there is a very great reduction in the labor. Mr. Barrett received me cordially, showing me all over his plant, gave me every facility, and offered to give me a pass to go to his works and examine it at my leasure.

The President — Thank you, Mr. Sherman, for that explanation. As no one else seems desirous of saying anything on the matter we will continue the general subject of calling on Dr. Schniewind, of the United Coke and Gas Company, for his remarks.

Otto-Hoffmann Coke Oven Practice.

Dr. Schniewind — Mr. President and gentlemen, I wish to express my thanks for your kind invitation to have me discuss our Otto-Hoffmann coke oven plant prior to your visit to the Everett works to examine it in detail. I wish to say that in a general way our Otto-Hoffman process is a coal gas process. The chief difference, as compared with the ordinary gas retort process, is that we charge larger quantities of coal. Our charging capacity per retort is about 12,000 pounds to 14,000 pounds. We furthermore, instead of carbonizing the coal by means of burning coke, are burning a part of our gas under the coke ovens. Of course, handling the coal in larger quantities as we do saves considerable in labor. Furthermore we have paid a great deal of attention to the saving of the by-products, and we think we are obtaining better results on that account. This process has been finding its development so far chiefly in connection with blast furnaces for the manufacture of metallurgical coke, and it is only of late that a few plants have been built or are building, which save illuminating gas in addition to the manufacture of coke. We have in operation in Germany 4,000 coke ovens with a saving of by-products, and nearly 8,000 without the saving of by-products. I have placed these figures on a chart which you will have opportunity to examine at your leisure.

Otto-Hoffmann Ovens Completed in United States and Canada.

Cambria Steel Co., Johnstown, Pa.	160
Pittsburg Gas and Coke Co., Glassport, Pa.	120
New England Gas and Coke Co., Everett, Mass.	400
Dominion Iron and Steel Co., Sydney, C. B.	400
Hamilton Otto Coke Co., Hamilton, Ohio.	50
Total,	1,130

Ovens in Course of Construction.

Lackawanna Iron and Steel Co., Buffalo, N. Y.	564
" " " " " Lebanon, Pa.	232
South Jersey Gas, Electric and Traction Co., Camden, N. J.,.	100
Total,	896

Ovens in Operation in Germany.

With saving of by-products	4,000
Without saving of by-products	7,700
Total,	11,700

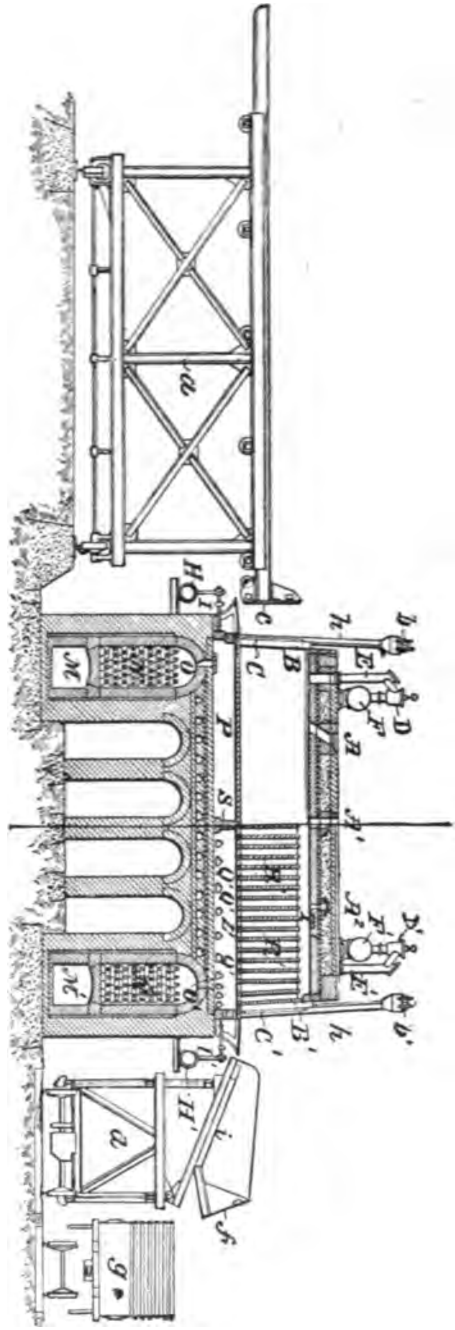
We have in this country in operation now 1,130 coke ovens, and are building 900, so that at the end of this year about 2,000 of them will be in operation. Of these ovens we have only three plants in operation and in course of construction intended to save illuminating gas, the plant which we are to visit this afternoon—that of the New England Gas and Coke Company; with 400 ovens; one nearing completion at Hamilton, O., of 50 ovens; and a plant of 100 ovens which is building at Camden, N. J., opposite Philadelphia. I will give you, first, a general description of the plant, after which I will give you the results obtained from various coals of the United States and Canada; next we will discuss the products; namely, the coke, then the other by-products, and finally the gas. Of course this discussion can be only a general one. I will be pleased to answer fully later on any of the gentlemen who shall ask questions.

In order to better describe the plant I wish to call your attention to this blue print (indicating). Our retorts are large firebrick chambers. They are about 33 feet long, and about 6 feet high, and about 18 inches, on an average, in width. We charge the coal through three charging openings in the top of the oven, and we remove the coke by opening a door at each end of the retort, bringing a large ram or pusher opposite the oven and forcing the entire mass of coke, about 4 or 5 tons, out on to a receiving platform, which is movable. While the coke is coming out we quench it on the platform; and then, after it is cooled, we simply tilt it and put it into the coke car. Thus, from the moment that we receive the coal in the railroad car or in the vessel, whatever it may be, until we load the finished coke into the car, we don't touch it by hand at all; it is all done mechanically. We have 50 of these retorts, (which have a charging capacity of 6 or 7 net tons of coal) in one large block, which has a common heating system. The heating is done by gas. A net ton of coal gives us about 9,000 cubic feet of gas. We have at Everett 4,000 cubic feet of surplus gas and 5,000 which we require for the heating of the retorts. We, as I shall describe later on, improve the quality of this surplus gas by taking the first fraction driven off from the coal for the surplus, and heat the retort with the later 5,000 cubic feet, which is sufficient to carry on the coking process. This amount of fuel is very little when compared with

the amount of heat which is used in the ordinary gas retort for carbonizing. In order to accomplish what we do we have added to the retorts a Siemen's regenerator. The air, before it is admitted to the coke ovens, is forced by a large blower through this checkerwork which is highly preheated and then enters the bottom of the retort, and the gas is added from this end of the chamber and burns in a long flame. When the combustion is completed the heat rises through 16 vertical flues to an upper horizontal flue, and descends again through these 16 vertical flues on the other side, because we have a partition there, and finally, before it is admitted to the stack, it passes through the checkerwork and heats up this mass of brick, and then through this flue it is conducted to the stack.

When this regenerator has become hot and this one, comparatively speaking, is cold, we simply throw over for the entire battery of 50 ovens one valve, which admits the air here, and the gas will be in this pipe and the off gases will go through this flue to the stack. This is repeated at half hour intervals. The temperatures which we obtain in the side walls are about 1,300° C. here, and finally a temperature of only about 250° at the outlet to the stack, so that we have a very good utilization of the heat. Now, then, as to the gases which leave the retort.

The first 4,000 cubic feet would rise through a pipe on this side. That is conducted to the condensing house, where the ammonia and tar are extracted in the usual way. After the 4,000 feet have been driven off we close these valves and open a corresponding valve on the other side and carry this gas also through a condensing house, where it is deprived of tar, ammonia and other by-products, and then finally this is brought back for heating. When the oven is to be opened the valve is closed and the oven is disconnected from both gas mains. The ram goes opposite and throws the coke into the the loader and then it goes finally into the car. I don't want to detain you by the description of the condensing house, because you, as gas men, are familiar with all the details of these matters. There are very few deviations in it from ordinary gas house construction. We first cool the gas by air coolers, then by condensers. Then we have tar scrubbers to extract the bulk of the tar. Then we pass the gas through exhausters, which bring up the temperature of the gas slightly, which forces us



to bring it down again in the secondary coolers, and after this we pass it through the ammonia scrubbers.

In some plants, not in this country, but those in Germany we add to the condensing house a cyanide and benzol extractor, but as we want at Everett a high candle power we cannot extract the benzol from the rich gas. We will, however, provide later on an extraction of the benzol from the poor or second fraction of gas, and then, by evaporating the benzol and carrying it into the rich gas, increase the candle power to any desired degree. To speak a few words in general of the operations of the New England Gas and Coke Company, I wish to say that we have 400 ovens there in 8 batteries of 50 each. Their maximum pushing capacity is 360 ovens per day.

At present they are running about 300 ovens per day. The plant at full load has a capacity of 2,160 net tons of coal per day. The amount of coke which we are getting is readily disposed of in the city, partly to the railroads, partly to large steam consumers, and partly for domestic purposes. To this I will refer later in detail. The by-products are saved in the following manner: Tar, which is sold to a company which uses it for the manufacture of roofing paper, paving pitch, etc.; the ammonia is manufactured in the form of sulphate of ammonia and finds a very ready market. Then, finally, the gas is sold to the Massachusetts Pipe Line Company, which purifies it and sells it to the various gas works in the city.

I want to say a few works about the various coals in the United States and their results. I have prepared a small table

Yields of Various Coals in Otto Hoffmann Ovens.

	Coke, Per Cent.	Tar, Per Cent.	Sulphate Per Cent.	Total Gas per 2,000 Pounds Cubic Feet.
Average Operating Results—				
Everett, Dominion coal	72.83	4.99	1.010	About 9,000
Glassport, Youghiogheny coal	75.60	5.07	1.100	" 9,000
Germany, Westphalian coal . .	74.50	3.70	1.280	" 9,600
Distillation Tests—				
Connellsville coking coal . . .	76.34	6.14	1.223	" 8,924
Pittsburg " " . .	68.25	4.38	.908	" 8,884
Eastern Pa., " " . . .	85.00	2.00	.800	" 8,400
Virginia " " . . .	66.01	4.70	1.070	" 10,090
Kanawha " " . . .	73.60	6.40	1.000	" 10,289

naming a few standard coals and giving the results from the same, but as I don't think you all can read it at a distance I will read off a few important figures. The carbonization of the Dominion coal which we are using at Everett gives us 72.8 per cent. of coke, 4.99 per cent. of tar, 1.01 per cent. of sulphate, and 9,000 cubic feet of gas per ton of coal. Pennsylvania coals, like, for instance, the Glassport and Connellsville coals—at Glassport we use the Youghiogheny coals—give us 76.3 per cent. of coke, 6.14 per cent. of tar, 1.223 per cent. of sulphate and 8,924 cubic feet of total gas. Coals, which give about 72 to 76 per cent. of coke, give us a surplus of between 3,000 and 4,000 cubic feet of gas per net ton. If the coke yield becomes higher (for instance, from Eastern Pennsylvania coals we get 85 per cent. of coke) then we get approximately the same amount of gas, namely, about 8,000 to 9,000 cubic feet of gas, but of such low heat value that we require the entire amount of gas for carrying on the coking process, and we have none to spare. So the limit, I should say, of the capacity of operating these works would be with coals yielding between 85 and 87 per cent. of coke. The Southern coals, like, for instance, the Virginia and West Virginia coals, are giving surprisingly good results.

The gas yield of the Virginia coal is 10,090 cubic feet per 2,000 pounds, with 66 per cent. of coke only. You can judge readily that this must be a gas of very good value. The important feature seems to be that we are able, by separating the gas into two fractions, and taking only the richer part of it, to use other than gas coals. Any ordinary coking coal, like the Connellsville or Youghiogheny coking coal, should furnish us a gas of between 18 and 20 candle power. We can thereby make use, also, of slack coal, to make a very high grade illuminating gas; but only in case we can dispose of the coke for domestic purposes. We also can combine the process with a regular metallurgical blast furnace coke plant, as, for instance, we have done in the neighborhood of Pittsburg. The Glassport plant is making a metallurgical coke, and at the same time can give us an illuminating gas of 18-candle power.

Now, in regard to the disposal of the coke. The great matter of importance is, that we make our coke in a manner entirely different from that in which the ordinary gas house coke is made. We charge into the retorts, as I said, between 6 and 7

tons in a layer about 6 feet deep. Consequently the coke is a great deal denser and, provided the analysis is all right, fit for metallurgical purposes. We have, for instance, proved that from Connelsville coal we make better coke than the standard beehive. We have carbonized many thousand tons and passed those through a test in a blast furnace that was set aside for the purpose, and found that we use between 5½ to 9 per cent. less coke than the standard beehive Connellsville. The coke comes out of the retort in the form of a solid wall which splits in the center, and the pieces average about 9 inches long and about 4 inches in diameter. If we want to use this coke for domestic purposes of course we have to pass it through crushers and screens and prepare it in the proper sizes. The chief uses to which our coke had been put heretofore are: For metallurgical purposes, for foundries and smelters, for various manufactures, like brass foundries and breweries, etc., railroads and stationary boilers, and then as domestic coke in competition with anthracite.

This is a market which is of the greatest importance. The smoke nuisance in all the large cities of the United States has been so fully recognized that large quantities of anthracite are used everywhere. The anthracite fields of the United States are unfortunately limited, and confined to a certain territory, and the freight is quite often prohibitive. On the other hand, bituminous coal fields are very close by a great number of large cities, and by means of our process we are able to convert this into a smokeless fuel, which is equal to the anthracite, and at the same time save a large amount of gas and other by-products. The present disposition of the coke at Everett, is: 700 gross tons per day to railroads, 350 to steam consumers, and 350 for domestic purposes, which is chiefly distributed by teams. The matter of advertising gas stoves has been up this morning. I want to call attention to the very clever manner in which Mr. Finn, the General Manager, has advertised the sale of the coke. He puts the domestic coke in small bags of about 20 pounds each, and sent those out by teams to grocers, who sold it for 10 cents a bag. People tried these bags and were pleased with the coke, and after a few weeks the grocers commenced to complain that whenever a customer had bought a bag he did not come back and buy the second one, the reason being that he had placed half ton or ton orders at the coke office. Mr.

Finn, by giving them a commission and allowing them to take larger orders, satisfied them, and the coke is thus quite readily introduced and appreciated.

In regard to the by-products, I want to say that per thousand of gas which we produce we obtain a larger quantity of by-products than is obtained from the ordinary gas retorts, for two reasons; First—Our yield, or the percentage, is higher on the coal carbonized; and, second, as we only use a part of the gas which is driven off from the coal, we require the carbonization of more coal in order to produce a certain amount of gas. I made a table of comparison which shows that per 1,000 feet of gas output the carburetted water gas plant would consume

Comparison of Products per 1,000 *Cubic Feet of Gas.*

	Carburetted Water Gas.	Coal Gas Retorts.	Otto-Hoffmann Process.
Coal or coke consumed . .	40 pounds coke or anthracite	224 lbs.	448 lbs.
Oil " " . .	30 lbs.	. . .	. . .
Coke produced	. .	110 lbs.	315 lbs.
Tar "	.5 gals.	1.12 gals.	2.25 gals.
Sulphate of ammonia . .	. .	1.8 lbs.	5.5 lbs.

about 40 pounds of anthracite coal, while an ordinary gas plant would use about 224 pounds, and we use about 448 pounds of coal; just twice as much. In addition to that, of course the water gas plant uses oil. The products which we obtain, are the following: In carburetted water gas only the tar is produced which comes from the oil; in ordinary coal gas retorts per 1,000 of gas we would obtain about half of the coal consumption, that is, about 110 pounds in coke, $1\frac{1}{8}$ gallons of tar, and $1\frac{8}{10}$ pounds of sulphate of ammonia, while with our process we would obtain 315 pounds of coke, for which we must find an outlet, $2\frac{1}{4}$ gallons of tar, and $5\frac{1}{2}$ pounds of sulphate of ammonia. That seems to most of the gas men a serious objection to this process, because he thinks we would simply swamp the market with by-products and would thereby reduce the value of the same, but this holds hardly true. The same objection was made when we started with the erection of the first 60 ovens in this country, but since then we have erected 1,130, and find a very ready market for all the products, even to the extent that we have contracts for the disposal of them for many years, in part even 5 year contracts at very good prices.

In other words, the fact that those products are being supplied now in this country has created a demand for them. Exactly the same was the case in Germany, where there are now over 5,000 ovens in operation, the by-products from which are quite readily disposed of, even to the extent that tar and ammonia have to be imported from England in order to satisfy the demand. This holds especially true in regard to tar, for which everybody fears the market will be overcrowded. The fact that they have 5,000 ovens in Germany, and dispose of all the tar, though they use but very little roofing paper in Germany, and paving pitch is practically unknown, makes me believe that in this country an additional market can be created as soon as it is taken up. In this country all the tar is going into the manufacture of roofing paper and paving pitch, and practically none is used for chemical and briquette purposes. So that if these industries are transplanted from abroad into this country now, since the raw material is supplied, there seems to be the best chance that a very large new demand can be created.

Furthermore, I want to call your attention to the fact that the tar which we produce is of a very different quality from the ordinary gas works tar. In the gas retort the gas has to pass along a very highly heated retort, and will come in contact with a large area, which gives a chance for cracking up hydrocarbons and producing lampblack. This lampblack, of course, is going into the tar. The ordinary gas house tar has about 25 per cent. of this free carbon or lampblack. With us the gas is very readily removed from the gas retorts, and therefore we have only between 5 and 8 per cent. of free carbon in the tar. This is especially important in the value of pitch for all kinds of binding purposes; for instance, in street paving, etc. The pitch used for those purposes is between 60 and 70 per cent of tar. In the gas house pitch the free carbon would be about 42 per cent., which leaves about 58 per cent. of a binder only, while in ours it is only 13 per cent. of carbon and 87 per cent. of binding material, which to the corresponding extent enhances the value of the coke oven product. Then another outlet may be found in competing with petroleum and petroleum products. You know that benzol has been used quite extensively for enriching gas. If only sufficient coke oven benzol will be supplied to the gas industry, a great deal more gas will be enriched by it instead of by oil. There are

other cases. For instance, the crude oil is used extensively as fuel or for the manufacture of lampblack; we have proof that tar is at least equal in its value to crude oil for that purpose. Also, lubricators are manufactured from petroleum and from tar as well. Finally, the carbon which results from the distillation of petroleum is used for the manufacture of electric light carbons, and the same can be done with the carbon which remains from the distillation of tar.

If I call your attention to the fact that the United States in 1899 produced 57,000,000 barrels of petroleum, and that even with the existence of 30,000 coke ovens, which would carbonize 50,000,000 tons of coal, the total production of tar would be only 10,000,000 barrels, you see what an enormous field there is before us in that direction. Finally, in regard to the ammonia, I wish to state that we manufacture it in two different forms, either as sulphate of ammonia, such as is done over at Everett, or in the form of concentrated liquor. The sulphate of ammonia is used for various purposes, chiefly for the making of anhydrous ammonia for the manufacture of ice, for refrigerating, etc., or it is used as fertilizer. For these fertilizing purposes we have an enormous outlet before us, because the demand for fertilizers in this country has been growing right along. This will be especially plain to you when I say that the United States have consumed, for nitrogenous fertilization in the year 1899, only about 150,000 tons of Chili saltpeter (the direct competitor of sulphate of ammonia) and between 35,000 and 40,000 tons of sulphate of ammonia, while Germany consumed 450,000 tons of Chili saltpetre and 150,000 tons of sulphate of ammonia. The results, of course, are plain in the larger yields per acre of ground. Take the yield of wheat, for instance, by the official statistics of a few countries. In Denmark, per acre, the yield is 41.8 bushels of wheat; in Germany, 23.2; and in the United States only 12. There is an enormous chance for improvement, and the various agricultural stations of the United States are looking into this matter and are making a very efficient propaganda in this direction. The nitrate of soda, as I stated, is imported into this country at the rate of 150,000 net tons per year. At present sulphate of ammonia is considered a better fertilizer and the rates for it are higher. Nitrate of soda contains 15½ per cent. of nitrogen against 20 per cent. in sulphate of am-

monia. If we base it on a like quantity of nitrogen contained in both, we find that the prevailing market prices are, for 1 ton of nitrogen, in saltpetre, $238, and 1 ton of nitrogen in sulphate, $280. If the price of sulphate should fall to that level that nitrogen will cost the same as in saltpetre, then there would be an unlimited market before us which we can supply, not counting even the increase that is possible and that will be obtained in a few years.

There are, furthermore, these additional by-products which I mentioned before: Benzol, toluol, solvent naphtha, naphtha— which we propose to extract only from the poor gas instead of extracting it from the entire gas, as is done in Germany. Also, there is cyanide and sulphur, which has already been mentioned by Mr. Shelton in his paper. This cyanide recovery process is finding a greater and more extended use right along, because the demand for cyanide, on account of its use for gold extraction, is constantly increasing. The process followed is simply employing a sulphate of iron solution, which extracts the cyanide at the outlet of the tar scrubbers, and then the gas which passes to the purifying house is free of this cyanide, leaving the spent oxide suitable for the manufacture of sulphuric acid. Now I come to the most important subject of all, the gas. I stated before that we fractionally separate the gas, sending only the rich or first part out into the city. At Everett the quantity we get is 4,000 cubic feet per net ton.

Everett Gas.

	Rich Gas.	Poor Gas.
Quantity per net ton coal, cubic feet	4,000	5,000
Analysis — Illuminants	5.0	2.5
Marsh gas	27.5	29.2
Hydrogen	44.3	51.8
Carbon monoxide	6.2	5.0
	93.0	88.5
Carbon dioxide	2.9	2.0
Oxygen	.1	.4
Nitrogen	4.1	9.1
	100.1	100.0
Heat Value—B. H. U.	707.8	515.0
Illuminating Value—C. P.	18.5	8.0

This gas is of 18½ candle power unenriched, but simply purified. The second, or poor gas, is 5,000 cubic feet in quantity,

which has an average candle power of 8. The analyses of the two gas fractions I have tabulated, and they are very interesting for comparison indeed. You see the illuminants in the rich gas are 5 per cent., against only $2\frac{1}{2}$ in the poor gas. I may say that in the poor gas the illuminants consist entirely of benzol, so that if the gas passes through a benzol washing apparatus the candle power disappears completely, showing us that we can take from this poor gas all the illuminant and transfer it to the rich gas, the purpose of which I shall state later. The marsh gas is very much higher in the first than in the second fraction. This finds its direct proof in the high calorific value of the rich gas as compared with the poor gas. You observe that the rich gas has a calorific value of 708 B.H.U. against 515 of the poor gas. Then, the hydrogen is very much lower in the rich gas than in the poor gas, and the other constituents and impurities remain about the same. The main point is that the rich gas has 18.5 candle power and the poor gas has 8 candle power. As we have in the poor gas 5,000 cubic feet of 8 candle power, we have for each ton of coal carbonized 40,000 candle feet evolved, which we can put into rich gàs. Thus we can take more of the rich gas away from the coke ovens, depending on an auxiliary heating plant for the ovens to make up the difference. In that manner we are able to follow the fluctuations of the gas consumption that gas works experience. In other words, we are able to maintain all the year round the supply of 18 to 20 candle power gas, and depend upon producers for heating the ovens to make up the difference of the fuel value which we take away from the ovens. You may say, then, if we depend on benzol for enriching our gas (the benzol which we take away from the poor coke oven gas) will the gas not diminish in candle power on transportation? This, by the latest experience which Mr. Shelton referred to in his paper, has been proven not to be so in Germany, It is very plain, if you consider the vapor tension of benzol, at the freezing point of 32° F. The gas, if enriched by benzol only, would still retain 38.7 candle power, so we are in very safe hands. Taking the benzol from the poor gas, you will see readily that we are absolutely independent of enrichers, either in the form of gas coal or oil. Any bituminous coal which we take we can convert into a high candle power gas. I shall have the experiments

which confirm these figures and statements put before you this afternoon at Everett. Finally, I have to say a few words here regarding purification. The Dominion coal which we carbonize at Everett is very high in sulphur, as you know, which necessitated a very elaborate purification plant. There is nothing that is patent to the system, and it depends entirely on the quality of the coal to be carbonized. I think that is all I have to say just now. I hope you will enjoy your visit this afternoon, and if any of you have any questions to ask I shall be glad to answer them. (Applause.)

Discussion.

The President — Gentlemen, I am sure we all appreciate the doctor's giving us this lecture. I propose to have a few minutes here and keep our cars waiting. It is only just 1 o'clock. The cars would start naturally in three-quarters of an hour, but if we delay them till two o'clock we still have an hour, which will enable us to get a bite to eat and still get the cars in good time. So this matter will be open for discussion.

Mr. Neal—I was very glad to hear what Dr. Schniewind had to say on the subject. The Charlestown Gas and Electric Company is taking gas from the Pipe Line Company, made at the New England Gas and Coke Company's works—the service began last of October, I think—and the gas has averaged over 18 candles all along. I must say the gas as an illuminant has been very satisfactory. Once, according to the statement of the State Gas Inspector, Mr. Jenkins, the sulphur was very high; but it averages no more than the average of sulphur from the gas as we made it; that is from coal and from water gas. I think this morning the candle power of the gas was 18.7. The pressure at the valve where the gas is delivered from the 24-inch main into our mains is sometimes as high as 14 when the holder is full, sometimes 12, but never below 7 inches, and, therefore, we have not seen any occasion so far for the use of an exhauster. I hope we shall not be obliged to use an exhauster, because it is an expense. So I wish to give my testimony as to the good quality of the gas, and that it is very satisfactory to our consumers. The sale of coke by the Gas and Coke Company does not affect the sale of coke from our station at all. We cannot meet all our calls for coke now, and have given orders not to take any applications at the office down town. We have none on hand.

The President—Does any other gentlemen wish to ask any questions of Dr. Schniewind? Of course, all can ask questions at the Everett Works later on. As no one seems desirous of furthur questioning the Doctor, we will adjourn to the works of the New England Gas and Coke Company to meet in the meter room a little later in the afternoon, adjourning formally from there. I wish to say it was anticipated that the Committee on Obituaries of deceased members would not report until after the meeting, sending the resolutions to the Secretary.

AFTERNOON SESSION.

After thoroughly inspecting the works of the New England Gas and Coke Company at Everett, the members assembled in the meter room of the works, where they were called to order.

The President—The Secretary having arrived, Dr. Schniewind is prepared to answer any questions that you wish to ask. I suppose practically all the questions you could ask have been answered in going around. The photometer here is at your disposal after the meeting has adjourned, and Dr. Schniewind will be very glad to show the candle power, if anyone wishes to examine it. There were a number of unanswered questions in the question box.

On motion of Mr. C. J. R. Humphreys, the discussion of the remaining questions was postponed until next year.

Votes of Thanks.

The President — Mr. Secretary, is there any further business? If not a motion of adjournment is in order.

The Secretary — Mr. President, before that motion is put I would like to move a vote of thanks to the retiring President for the manner in which he has assisted the Secretary during the last two years. I assure you this is a matter which has touched me very deeply. While of course the Secretary usually takes all the credit of the meetings, yet in this case it has been otherwise. It has been personally a great favor to me to be thus brought in contact with the President, and having this business on hand has given me an excuse for climbing his office stairs more frequently than I have felt at liberty to do in the past. I don't know how the future will be about that. I wish to make that motion, and hope you will all second it. We will consider the motion carried.

The President — Gentlemen, before I refer again to the Secretary, I want to extend the thanks of the Association to Dr. Schniewind for, first, the explanations at Young's Hotel, and for toting us all around. I would like to extend thanks also to Mr. Greims and to his assistants, who took us in detachments. I would like also to express our thanks to Mr. Finn, of the New England Gas and Coke Company, for the sandwiches that I did not get, but probably some of you did. Gentlemen, I said what I felt was right in my opening address about the Secretary, and I want not only to extend the thanks now of the President, but also the thanks of every member of the Association, for what he has done at this meeting. He will be with you next year, so that you can still further cover him with thanks and keep him up to his duty. Now, Mr. Secretary, will you accept the thanks of the Association?

Report of Committee on Memorial.

MR. JOHN M. HILL.

The Committee appointed by the President to prepare a tribute to the memory of Mr. John M. Hill, a member of this Association, who passed away since its last meeting, report as follows:

Mr. John M. Hill, late of Concord, N. H., was born in that town, November 5th, 1821, and died there March 3d, 1900. He was one of Concord's best known and most influential citizens, and his death was sincerely regretted by the people of his city and State.

In the year 1856 he accepted the position of Treasurer and Manager of the Concord Gas Light Company, which position he held continuously during a period of 33 years, discharging his duties faithfully, honestly and successfully.

He was one of the founders of the New England Association of Gas Engineers, was elected a Director at its first meeting, in the year 1871, and served in that capacity 9 years. As a member and as a Director, he took pleasure in promoting the usefulness and welfare of the Association.

During his long and busy life he held many positions of honor and trust in city and State.

He left behind him a pleasant memory of a useful and well-spent life.

GEORGE B. NEAL,
HENRY F. COGGESHALL, } *Committee.*

HENRY A. ATWOOD.

Your committee appointed to draught suitable resolutions on the death of Henry A. Atwood, a member of this Association, would respectfully report the following:

The death of our esteemed friend and fellow member occurred on Saturday, March 17, 1900, at his home in Plymouth. Henry Almon Atwood was born in Providence, April 5, 1836. For the past twenty years he has filled the position of Manager and Superintendent of the Plymouth Gas Light Co. in an able and efficient manner. After an illness extending over many months, during which he bore his afflictions with courage and resignation, he was laid to rest at Dedham, where he had formerly resided. Your committee would recommend that the Secretary be instructed to express to the family of the deceased, the regret which we have felt, in being called upon to part with our old friend, and to extend to them our heartfelt sympathy.

H. A. ALLYN,
W. A. LEARNED, } *Committee.*

GEO. TREDWAY THOMPSON.

Your committee appointed to recommend action in connection with the death of Mr. Geo. Tredway Thompson, have the honor to report the following Resolution:

Resolved, that The New England Association of Gas Engineers learns with regret of the untimely death of George Tredway Thompson and makes this record of its appreciation of his efforts and accomplishments in behalf of the industry of gas supply, and of his many endearing qualities of mind and heart.

WALTON CLARK,
WILLIAM E. MCKAY, } *Committee.*

ROBERT R. SMITH.

Robert R. Smith died at his home in New Hartford, Conn., May 13, 1900. He was born in New Hartford, April 15, 1843, and almost within view of his birthplace was the whole of his useful life spent.

He was educated in the schools of the town and began his business life in Chicago where he was for a short time clerk in a mercantile establishment.

In 1869, he was appointed Agent of the newly organized Greenwoods Scythe Company of New Hartford, and in 1873 was chosen president of this concern which was the same year absorbed by the Greenwoods Company. On the death of his father, John C. Smith, who was president and resident agent of the Greenwoods Company, the son, Robert R. Smith, succeeded his father as agent and continued as the local manager of the company's affairs in this town until his death.

Mr. Smith was one of New Hartford's most prominent citizens and was always ready to help on a good cause. Mr. Smith had been a member of the New England Association for nearly three years before his death and represented the Greenwoods Company which concern owns the gas plant in the village of New Hartford.

His death leaves a very large void in the community where his useful life was spent.

CHARLES H. NETTLETON, }
F. C. SHERMAN, } *Committee.*

FRITZ H. TWITCHELL.

WHEREAS, since the last meeting of this Association one of its members, Bro. Fritz H. Twitchell of Bath, Me., has been removed by death, and

WHEREAS, it is fitting that his removal from the scenes of activity should be recognized by his associates, therefore:

Resolved, that this Association record its appreciation of his merits. He was a native of Portland, Me., and for many years was engaged in active business in the city of Bath, where in connection with many other business enterprises he was treas-

urer of the Bath Gas and Electric Light Company. He was Mayor of the city of his adoption, represented that city in the house of representatives, was a high official in the Masonic and Pythian fraternities, and was prominent in many circles.

Resolved, that that this Association extends its sympathy to the members of his family; that a copy of these resolutions be spread upon the records, and another copy sent to the family of the deceased.

JOHN A. COFFIN,
EUGENE H. YORK, } *Committee.*

A motion to adjourn was adopted.

OFFICERS

OF THE

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS

MARCH 1, 1901.

President:

WALDO A. LEARNED.

Vice Presidents:

WILLIAM E. McKAY, COL. F. S. RICHARDSON.

Secretary and Treasurer:

N. W. GIFFORD.

Office, New Bedford, Mass.

Directors:

WM. McGREGOR, W. G. AFRICA, JOS. E. NUTE,

WM. H. SNOW, B. J. ALLEN.

PRESIDENTS.

*William W. Greenough,	1871–1875
*George D. Cabot,	1875–1877
*Samuel G. Stiness,	1877–1880
William A. Steadman,	1880–1882
Alpheus B. Slater,	1882–1884
Malcolm S. Greenough,	1884–1886
John P. Harbison,	1886–1888
*Alfred M. Norton,	1888–1889
Robert R. Taber,	1889–1890
Charles F. Prichard,	1890–1891
Horace A. Allyn,	1891–1892
William A. Wood,	1892–1893
Charles H. Nettleton,	1893–1895
Charles H. Lamson,	1895–1897
Samuel J. Fowler,	1897–1899
Walter R. Addicks.	1899–1901
W. A. Learned,	1901 ——

SECRETARIES.

*Geo. B. Neal,	1871–1884
Chas. H. Nettleton,	1884–1892
Chas. F. Prichard,	1892–1899
N. W. Gifford,	1899 ——

*Deceased.

MEMBERS

OF THE

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS

MARCH 1, 1901.

Honorary Members.

*JOSEPH R. THOMAS, Gas Engineer and Editor of American Gas Light Journal, 32 Pine St., New York, N. Y.

GEN. ANDREW HICKENLOOPER, President Cincinnati Gas Light and Coke Co., Cincinnati, O.

EMERSON MCMILLEN, President Columbus Gas Light and Coke Co., Columbus, O., 40 Wall St., New York, N. Y.

COL. FREDERICK S. BENSON, Engineer Nassau Gas Light Co., Brooklyn, E.D., N. Y.

EUGENE VANDERPOOL, Civil Engineer, Newark, N. J.

*WILLIAM W. GREENOUGH, ex-Treasurer and Engineer Boston Gas Light Co., 299 Marlboro St., Boston, Mass.

CAPT. WILLIAM HENRY WHITE, Constructing Gas Engineer, 32 Pine St., New York, N. Y.

*GEORGE D. CABOT, Director Lawrence Gas Co., Lawrence, Mass.

COL. JAMES H. ARMINGTON, Consulting Engineer Brooklyn Gas Light Co., Riverside, R. I.

AUSTIN C. WOOD, Gas Engineer, Syracuse, N. Y.

THOMAS F. ROWLAND, President Continental Iron Works, Brooklyn, N. Y.

WILLIAM A. STEDMAN, Vice President and General Manager Flatbush Gas Light Co., Brooklyn, N. Y.

*Deceased.

Active Members.

Addicks, Walter R., Chief Engineer Boston and Bay State Gas Companies, 24 West St., Boston, Mass.

Africa, Walter G., Treasurer and Superintendent People's Gas Light Co., Manchester, N. H.

Alden, George A., Assistant Superintendent Newton and Watertown Gas Light Co., Watertown, Mass.

Allen, B. J., Superintendent Allston Station, Brookline Gas Light Co., Allston, Mass.

Allyn, Horace A., Superintendent Cambridge Gas Light Co., East Cambridge, Mass.

Armory, Dr. Robert, 40 Water St., Boston, Mass.

Anderson, William, Superintendent East Boston Gas Light Co., East Boston, Mass.

Anthony, A. C., Assistant Superintendent South Station, Providence Gas Co., Providence, R. I.

Barnum, D. D., Chemist Worcester Gas Light Co., Worcester, Mass.

Bartlett, Lewis, Superintendent Cottage City Gas and Electric Light Co., Cottage City, Mass.

Bledsoe, John H., Superintendent The Gas Light Co. of Waverly.

*Blood, Frederick C., Superintendent Ware Gas Light Co., (with Otis Co.) Ware, Mass.

Boardman, Henry, Bangor, Me.

Bradley, William H., Engineer-in-Chief Consolidated Gas Co., of New York, 4 Irving Place, New York, N. Y.

Burritt, D. F., Manager Rockville Gas Light Co., Rockville, Conn.

Bush, Robert W., Engineer Metropolitan Gas Light Co., Twelfth St. and Gowanus Canal, Brooklyn, N. Y.

Cabot, John, Manufacturer of Gas Trays, 553 to 557 West 33d St., New York, N. Y.

*Deceased.

Christian, George H., Manager Spencer Gas Co., Spencer, Mass.

Clark, Walton, Manager Concord Gas Light Co., address, Philadelphia, Pa.

Coffin, John A., Superintendent and Agent Gloucester Gas Light Co., Gloucester, Mass.

Coffin, Isaiah E., 139 Oxford St., Providence, R. I.

Coggeshall, H. F., Treasurer and General Manager Fitchburg Gas and Electric Light Co., Fitchburg, Mass.

Cook, Ralph W., Providence, R. I.

Cooper, Arthur F., Superintendent Exeter Gas Light Co., Exeter, N. H.

Cowperthwaite, George E., Secretary and Superintendent Danbury and Bethel Gas Light Co., Danbury, Conn.

Coyle, Patrick, Superintendent Charlestown Gas and Electric Co., Charlestown, Mass.

*Crafts, David W., Superintendent Northampton Gas Light Co., 145 Main St., Northampton, Mass.

Crafts, Harry C., Superintendent Northampton Gas Light Co., Northampton, Mass.

Cranford, R., Superintendent The Gas and Electric Co., Stamford, Conn.

Darbee, William, Asst. Superintendent Gas and Electric Light Co., Portsmouth, N. H.

Davis, F. R., Treasurer and Superintendent Miller's River Gas Light Co., P. O. Box 158, Athol, Mass.

Dickens, James, Newburyport, Mass.

Dickerson, Arthur T., Superintendent Rockville Gas Light Co., Rockville, Conn.

Dole, C. E., Superintendent Gas Light Co., Bangor, Me.

Eccles, A. D., Superintendent Ware Gas Light Co., Ware, Mass.

Erhard, Theodore, Asst. Superintendent Cambridge Gas Light Co., 354 Third St., East Cambridge, Mass.

*Deceased.

Farnum, George W., Superintendent Lowell Gas Light Co., Lowell, Mass.

Fairbanks, F. P., Asst. Superintendent Holyoke Gas Co., Holyóke, Mass.

Fowler, Samuel J., Manager Charlestown Gas and Electric Co., Charlestown, Mass.

Frost, Charles T., Superintendent Plymouth Gas Light Co., Plymouth, Mass.

Frost, William H., President Fort Scott Light and Fuel Co., Fort Scott, Kan.

Gerdinier, C. A., Superintendent Bridgeport Gas Light Co., Bridgeport, Conn.

Gerdinier, Charles A., Asst. Superintendent Bridgeport Gas Light Co., Bridgeport, Conn.

Gerould, C. L., Manager Galesburg Gas and Electric Light Co., Galesburg, Ill.

Gifford, N. W., Superintendent New Bedford Gas Light Co., New Bedford, Mass.

Gilmore, Ogden, Norwich, Conn.

Gillette, Sanford E., Engineer Marblehead and Danvers Gas Companies, Danvers. Mass.

Gould, J. A., Chief Engineer Brookline and Dorchester Gas Light Companies, 24 West St., Boston, Mass.

Goulding, Norman O., Superintendent Natick Gas Light Co., Natick, Mass.

Graf, Carl H., Engineer Gas Dept., The Gas and Electric Co., Bergen Co., Hackensack, N. J.

Greenough, Malcolm S., Vice President and General Manager Cleveland Gas Light and Coke Co., Cleveland, O.

Hallett, Joseph L., 1730 Broadway, New York, N. Y.

Hanford, L. C., Superintendent Norwalk Gas Light Co., Norwalk, Conn.

Harbison, John P., Treasurer and General Manager Hartford City Gas Light Co., Hartford, Conn.

Hassett, Edward J., Superintendent Beverly Gas and Electric Co., Beverly, Mass.

Hawken, Thomas, Manager Knox Gas and Electric Co., Rockland, Me.

Hayden, W. H., 32 Pine St., New York, N. Y.

Hintze, Thomas H., Assistant Supt. Lowell Gas Light Co., Lowell, Mass.

Hirt, Louis D. Boston, Mass.

Humphreys, C. J. Russell, Agent Lawrence Gas Co., P. O. Drawer K., Lawrence, Mass.

Humphreys, A. C., 31 Nassau St., New York, N. Y.

Humphreys, J. J. Jr., Superintendent Worcester Gas Light Co., Worcester, Mass.

Hulburt, Samuel, General Manager Norwich Gas and Electric Co., Norwich, Conn.

Jenks, Z. M., Superintendent Woonsocket Gas Co., Woonsocket, R. I.

Jennings, Frank W., Superintendent Framingham Gas, Fuel and Power Co., South Framingham, Mass.

Jones, Edward C., Engineer San Francisco Gas and Electric Co., San Francisco, Cal.

Kelley, Henry H., Waltham, Mass.

Lamson, Charles Dudley, President and General Manager Worcester Gas Light Co., 240 Main St., Worcester, Mass.

Lane, F. H., Superintendent Gas Dept., Charleston Consolidated Ry., Gas and Electric Co., Charleston, S. C.

Lane, Howard M., Treasurer and Manager Leominster Gas Light Co., Leominster, Mass.

Lawrence, W. F., Engineer New York & Queens Gas and Electric Co., Flushing, N. Y.

Lawson, William H., Supt. Peoples' Gas Light Co., Rutland, Vt.

Leach, Henry B., Secretary, Treasurer and Superintendent Taunton Gas Light Co., Taunton, Mass.

Learned, Everett C., Superintendent New Britain Gas Light Co., New Britain, Conn.

Learned, Waldo A., General Superintendent Newton and Watertown Gas Light Co., Newton, Mass.

Learned, Chas. A., Superintendent Meriden Gas and Electric Light Co., Meriden, Conn.

Leonard, Chas. F., Asst. Supt. Fall River Gas Works Co., Fall River, Mass.

Long, Robert J., Superintendent West Point Gas Light Co., West Point, N. Y.

Lucey, F. J., Manager Natick Light Co., Natick, Mass.

Macomber, Geo. E., President Knox Gas and Electric Co., Rockland, Me.

Macmun, George F., Manager Marlboro Gas Light Co., Room 22, Corey Building, Marlboro, Mass.

Manchester, George L., Treasurer and Superintendent Easthampton Gas Co., Easthampton, Mass.

Manchester, J. Howard, Secretary, Treasurer and Superintendent Bristol Gas Light Co., Bristol, R. I.

Mansfield, Geo. W., Superintendent Salem Gas Light Co., Salem, Mass.

McGregor, William, Manager Pawtucket Gas Co., Pawtucket, R. I.

McKay, William E., Engineer in Charge Calf Pasture Station, Bay State Gas Co., Boston, Mass.

Miles, Chas. H., Manager Lexington Gas and Electric Co., Lexington, Mass.

Miller, Carroll, M. E., Consulting Engineer, Room 373, The Rookery, Chicago, Ill.

Milne, John D., Superintendent Gas Dept. Connecticut Light and Power Co., Norwalk, Conn.

Monks, Richard J., Agent and Treasurer Woburn Gas Light Co., 35 Congress St., Boston, Mass.

Mooney, E. B., Superintendent Brockton Gas Light Co., Brockton, Mass.

Moore, David, Salem, Mass.

Morrison, H. K., Superintendent Concord Light and Power Co., Concord, N. H.

Morse, Charles W., President and General Manager Amesbury and Salesbury Gas Co., Amesbury, Mass.

Moynahan, J. F., Superintendent Stoneham Gas Co., Stoneham, Mass.

*Neal, George B., Treasurer and Manager Charlestown Gas and Electric Co., Charlestown, Mass.

Nettleton, Charles H., President Derby Gas Co. and of New Haven Gas Light Co., Derby, Conn.

Norton, Harry A., Manager Nath'l Tuft's Meter Co., 8 Medford St., Boston, Mass.

Norton, Walter F., Superintendent Nashua Light, Heat and Power Co., Nashua, N. H.

Norton, P. T., Asst. Superintendent Nashua Light, Heat and Power Co., Nashua, N. H.

Nute, Joseph E., Superintendent Fall River Gas Works Co., Fall River, Mass.

Nutting, Charles H., Superintendent Chicopee Gas Light Co., Chicopee, Mass.

Nutter, E. J., Asst. Superintendent, Milford Gas Co., Milford, Mass.

Nutter, J. J., Superintendent Milford Gas Co., Milford, Mass.

Parker, F. H., Treasurer and Superintendent Burlington Gas Light Co., Burlington, Vt.

Prichard, Charles F., General Manager Lynn Gas and Electric Co., Lynn, Mass.

Purinton, A. J., Gen. Manager Central Mass. Electric Co. and Gen. Manager and Treasurer Palmer and Manson Street Ry. Co., Palmer, Mass.

Quinn, Andrew K., Treasurer and Superintendent Newport Gas Light Co., Box 305, Newport, R. I.

Deceased.

Richardson, Frank S., Vice President, Treasurer and Manager North Adams Gas Light Co., North Adams, Mass.

Rossman, George M., Treasurer and Superintendent Keene Gas Light Co., Keene, N. H.

Sargent, Fred. S., Superintendent Lawrence Gas. Co., Lawrence, Mass.

Shaw, Herbert S., Treasurer and Superintendent Webster Electric Co., Operating Gas Works, Webster, Mass.

Shelton, Frederick H., 112 N. Broad St., Philadephla, Pa.

Sherman, F. C., Superintendent New Haven Gas Light Co., New Haven, Conn.

Sherman, Charles D., Asst. Engineer New Haven Gas Co., New Haven, Conn.

Slater, Alpheus B., Providence, R. I.

Slater, Alpheus B., Jr., Consulting Engineer, 33 Adelaide Ave., Providence, R. I.

Snow, William H., Superintendent Holyoke Gas Works, Holyoke, Mass.

Spaulding, Charles F., Superintendent Waltham Gas Light Co., Waltham, Mass.

Spaulding, Charles S., Superintendent Newburyport Gas and Electric Co., Newburyport, Mass.,

Spaulding, William H.

Spear, John Q. A., 76 Minot St., Dorchester, Mass.

Spear James N., Supt. So. Boston Gas Light Co., So. Boston Mass.

Stearns, Walter M., Assistant Superintendent Waltham Gas Light Co., Waltham, Mass.

Stone, Arthur F., Supt. Chelsea Gas Light Co., Chelsea, Mass.

Stratton, W. L., Superintendent Haverhill Gas Light Co., Haverhill, Mass.

Taber, Robert B.

Tarbell, A. Willis, 165 Summer St., Waltham, Mass.

Terry, F. L., General Manager New London Gas and Electric Light Co., New London, Conn.

Thayer, William F.

Thompson, C. F. Treasurer and Manager Gas Light Co., Brattleboro, Vt.

Tilton, D. D., Treasurer and General Manager Newburyport, Gas and Electric Co., Newburyport, Mass.

Todd, John R.

Travis, F. M., New Haven, Conn.

Walker, Wm. L., Supt. Gas Works, Fitchburg, Mass.

Waters, John A., Assistant Superintendent Stamford Gas and Electric Co., Stamford, Conn.

White, Chas. E., Manager Municipal Light Plant, Wakefield Mass.

Willard, Albert T., Superintendent Greenfield Gas Light Co., Greenfield, Mass.

Williams, E. H., Assistant Superintendent Gas Co., Waterbury, Conn.

Wood, William A., Engineer in Charge Nort End Station, Boston Gas Light Co., 609 Commercial St, Boston, Mass.

Woodward, Ralph, Superintendent New Rochelle Branch Westchester Light Co., New Rochelle, N. Y.

Yorke, Eugene H., Engineer Portland Gas Light Co., Portland, Me.

Young, A. M., 100 Broadway, New York, N. Y.

Associate Members.

Addicks, F. P., 52 Broadway, New York, N. Y.

Allen, Walter S., New Bedford, Mass.

Austin, Calvin, Treasurer and Manager Citizens Gas Light Co. of Quincy, 368 Atlantic Ave., Boston, Mass.

Baker, Sydney E., Chief Clerk Fall River Gas Works Co., Fall River, Mass.

Barnes, A. M., Treasurer Cambridge Gas Light Co., Cambridge, Mass.

Baldwin, Chas. H., Manager National Meter Co., 159 Franklin St., Boston, Mass.

Brown, F. H., Superintendent Davis & Farnum Manufacturing Co., Waltham, Mass.

Brown, Geo. P., Manager Fall River Gas Works Co., Fall River, Mass.

Browne, A. Parker, F. H. Odiorne & Co., 86 State St., Boston, Mass.

Burrage, Albert C., 83 Ames Building, Boston, Mass.

Cheney, Herbert N., Draftsman Bay State Gas Co., 23 Gardner St., Allston, Mass.

Chandler, Frank C., President and General Manager Malden and Melrose Gas Light Co., 23 Merrimac St., Boston, Mass.

Cheney. Chas. H., General Manager Gas Works, Cheney Bros. So. Manchester, Conn.

Coburn, Cyrus M., Agent Alden Spear's Sons & Co., Chelsea, Mass.

Cortis, D. T., Gas Appliance Exchange, Welsbach Incandescent Gas Light Co., West St., Boston, Mass.

Dart, Edward M., Manufacturer Gas Cocks, 136 Clifford St., Providence, R. I.

Davidson, Rolland A., Electric Engineer Brookline Gas Light Co., Allston, Mass.

Davis, Frederick J., Davis & Farnum Manufacturing Co., Waltham, Mass.

Dunbar, Albert, Supt. Dist. Dept. Brookline & Brighton Div. Brookline Gas Light Co.

Farrington, Alfred N., Supt. St. Dept. Boston Gas Light Co., 24 West St., Boston, Mass.

Finn, Geo. H., General Manager New England Gas and Coke Co., 95 Milk St., Boston, Mass.

Fiske, John T., Salesman Schneider & Trenkampf Co., Concord, N. H.

Gardiner, Wm. Howard Jr., Consulting Engineer, 12 Pearl St., Boston, Mass.

Greims, A. F., Supt. New England Gas and Coke Co., Everett, Mass.

Hamlin, Herman R., Assistant. Supt. Street Dept., Boston Gas Light Co., 24 West St., Boston, Mass.

Hill, Wm. H., President Citizens Gas Light Co. of Quincy, 40 Water St., Boston, Mass.

Hinman, Charles W., 53 Front St., Charlestown, Mass.

Holmes, Rufus E., President Winsted Gas Co., Winsted Conn.

Huestis, Frank C., Meter Inspector Cambridge Gas Light Co., 367 Somerville Ave., Somerville, Mass.

Humphreys, Frank W., Dept. Manager New Haven Gas Light Co., 38 Howe St., New Haven, Conn.

Langwith, F. A., Novelty Machine Co., New Haven, Conn.

Mace, Frank W., Assistant Superintendent Lynn Gas and Electric., Lynn, Mass.

Macmun, Geo. F. Jr., Pawtucket, R. I.

Mason, Vinton W., Cambridge, Mass.

McKenney, W. A., McKenney & Waterbury, 165 Franklin St., Boston, Mass.

Merritt, Charles H., President Danbury and Bethel Gas and Electric Co., Danbury, Conn.

Montgomery, J. K., President Chelsea Gas Light Co., Chelsea, Mass.

Nichols, Wm. B., Supt. Distribution Dept., Roxbury Gas Light Co., 2 Kensington Park, Roxbury, Mass.

Norton, A. E., N. Tuft's Meter Co., Boston, Mass.

Plunkett, Wm. R., Treas. Pittsfield Coal Gas Co., Pittsfield, Mass.

Ruggles, Chas. S. J., Supt., Gas Fuel and Light Co., Gardner, Mass.

Pratt, Frank S., Equitable Building, Boston, Mass.

Scranton, George H., Derby, Conn.

Sprague, Phineas W., 70 Kilby St., Boston, Mass.

Thomas, F. W., Salesman Waldo Bros., 102 Milk St., Boston, Mass.

Thompson, H. G., President Novelty Machine Co., New Haven Conn.

Tobey, Franklin, Jr., General Manager Kingston Electric Co., Kingston, N. Y.

Todd, Robert, Foreman Dedham and Hyde Park Gas Light Co., Dedham, Mass.

Tudor, Frederic J., Treas. Mass. Pipe Line Co., 95 Milk St., Boston, Mass.

Tufts, Joseph P., with Nath'l Tuft's Meter Co., 8 Medford St., Boston. Mass.

Waldo, Charles S., 102 Milk St., Boston, Mass.

Waldo, J. Adan, 102 Milk St., Boston, Mass.

Wardwell, William R., with W. K. Niver & Co., 127 Milk St.. Boston.

Wilder, Chas. C., Traveling Salesman for J. H. Cunningham & Co., Newton, Mass.

Honorary Members,	9
Active Members,	143
Associate Members,	54
Total,	206

PREAMBLE

AND

ARTICLES OF AGREEMENT

OF

THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS

ADOPTED AT THE ANNUAL MEETING OF THE ASSOCIATION
FEBRUARY, 1888, AND AMENDED FEBRUARY, 1890.

PREAMBLE.

WHEREAS, The manufacture and supply of Gas has become one of the largest economic interests in the country; and, whereas, it is most important to the manufacturers and to the public that the best processes known shall be employed in its manufacture and distribution, and whereas, it is most desirable to obtain the advantage of the experience of the Gas Engineers scattered throughout New England upon the various problems presented for consideration, we, the undersigned, hereby agree to associate ourselves for the above named purpose, according to the following

ARTICLES OF AGREEMENT.

1. The association shall be called "The New England Association of Gas Engineers."

2. The annual meetings of the association shall be held in the city of Boston, Mass., unless otherwise ordered by the association, on the third Wednesday of February in each year, at such hour and place as the directors shall determine.

3. The officers of the association shall be a President, two Vice-Presidents, a Secretary and Treasurer, who, with five other members of the association elected for the purpose at an annual meeting, shall constitute a Board of Directors. Their terms of office shall continue till the close of the meeting at which their successors are elected.

4. Any New England Gas Engineer may become an active member upon application to the Secretary, accompanied by the endorsement of two active members of the association and the membership fee of five dollars, the approval of the Board of Directors and an election by three-quarters of the votes at any regular meeting of the association, and by signing an agreement to pay such assessments as may be levied by the Board of Directors. Any Gas Engineer may be elected an honorary member by the same vote as is required for the regular election of members of the association. Any person residing in New England and connected with industries pertaining to the gas business may become an associate member upon conditions prescribed for active members. None but active members shall vote or be eligible to office.

5. The administration of its affairs shall be intrusted to the officers of the association, of whom four shall form a quorum for the transaction of business.

6. The Secretary and Treasurer shall receive all moneys; he shall also notify all meetings, taking minutes of the proceedings at all meetings of the association, and enter them in proper books provided for the purpose. He shall write the correspondence, read minutes and notices at all the meetings, and also papers and communications, if the authors wish it; report discussions, and perform whatever duties may be indicated in the regulations of the association as appertaining to his department.

7. At any regular meeting of the association ten members shall be a quorum for the transaction of business.

8. All questions shall be decided by any convenient system of open voting; the chairman to have a second or casting vote when necessary. Questions of a personal nature shall be decided by ballot.

9. All papers proposed to be read at a meeting of the association must relate to matters directly or indirectly connected with the manufacture and distribution of gas, and must be approved by the Board of Directors before being read at such meeting.

10. All papers, drawings or models, submitted to these meetings shall remain the property of the authors.

11. If any person proposed for membership, on being balloted for, shall be rejected, no notice shall be taken of the proposal in the minutes.

12. The annual assessment shall be payable in advance, at or before each general meeting; and no member whose assessment is in arrears shall be entitled to vote. If any member shall neglect to pay his assessment for the space of two years, he shall cease to be a member of the association.

13. These articles may be altered or amended at any annual meeting, notice of such proposed change having been given to the Secretary at least thirty days previous to such meeting and by him communicated to all members, at least one fortnight previous to such meeting.

ERRATA.

6, third line, the word "strokers" should be "stokers."

122, in list of associate members, the name "Humeys, F. H." should be "Humphreys, F. W." The name m. Holmes" should be spelt "Wm. Homes."

e 138, third line, "F. B. Sherman" should be "F. C. erman."

ges 139 and 143, the title at top of page should be Thirty-first Annual Meeting."

ige 158, in remarks of Mr. Pratt, 7th line, the word able" should appear after "well."

ige 177, first line, "W. F. Humphreys" should be "F. W. Humphreys."

age 181, in remarks of Mr. Norris, 17th line, "$5\frac{1}{2}$" should be "$15\frac{1}{2}$."

page 219, in article "Selling Gas," 2d line, the word "not" should appear after "I am."

page 254, "Beckon" should be "Beckton."

(A)

TO THE

New England Association

OF

GAS ENGINEERS.

I desire to become an active member of your Association, and respectfully submit this application therefor. And agree, if elected, to conform to the requirements of the Constitution.

....
(NAME OF APPLICANT)

....
(POSITION HELD BY APPLICANT)

....
(NAME OF COMPANY APPLICANT IS WITH)

....
(ADDRESS OF APPLICANT)

....

....

Date, ... *19*..........

We hereby approve and endorse the above application for active membership.

.... } *Active Members.*

....

Approved by Directors, ...

Date of Election, ...

....*Secretary.*

(C)

APPLICATION BLANK — TRANSFER.

TO THE

New England Association

OF

GAS ENGINEERS.

The undersigned associate member of the Association respectfully asks to be transferred to the class of active members.

....
(NAME OF APPLICANT)

....
(POSITION HELD BY APPLICANT)

....
(NAME OF COMPANY APPLICANT IS WITH)

....
(ADDRESS OF APPLICANT)

....

....

Date, ... *19*..........

We hereby approve and endorse the above application for active membership.

.... *Active*

.... *Members.*

Approved by Directors, ...

Date of Election, ...

....*Secretary.*